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CAUVERY RESERVOIR PROJECT IN MYSORE.

REPORT.

1.—PRELIMINARY.

The River Cauvery has its origin in the Western Ghats about 20 miles to the south-west of Mercara, the principal town in Coorg. The total length of the river within Mysore Territory and along its southern boundary is about 150 miles. The drainage area contributing to the river within the State is 11,498 square miles and that in Coorg and Wynaad, above Mysore, 1,593 square miles.

2. The river is situated in a region where it is of special value for both irrigation and power supply. It has been used for irrigation from time immemorial by means of anikats and channels. The anikats being low store little or no water. The channels, none of which are of any considerable length, are taken over broken country and more or less parallel to the river and they only serve to irrigate the thin strips of intervening land. About 108,000 acres, chiefly rice, are irrigated in the valley at present and they require water for five to seven months between June and January. Further extension is limited by the short supply in the river and its irregular distribution towards the end of the irrigation season.

3. Since 1902, the river has been harnessed at the Sivasamudram Falls to generate electric power and about 11,000 H.P. is generated and transmitted for use to the Kolar Gold Fields and the cities of Bangalore and Mysore. The power supply is exposed, even more than irrigation, to risks from short supply, and every hot weather temporary arrangements have to be made by artificial means to increase the river flow. The demand for power protection has been so great that the supply of water for irrigation has come to be regarded as of secondary importance.

4. Whether for irrigation or power supply, the river in its natural state is already fully exploited. For any further profitable advance, a departure from old methods of construction is necessary. A large reservoir for storing water, canals to command wide expanses of level country, a scientifically planned system of water distribution and a progressive scheme of power development will constitute this new departure.

A new departure.

5. The variations in the river flow are very considerable. The quantity gauged at Sivasamudram is 300,000 cubic feet per second or more in the monsoon, and it occasionally falls to less than 100 cubic feet per second in the driest part of a dry year. If sufficient storage be provided to supplement the natural river flow during months of short supply in the two seasons, a great increase in the area irrigated and in the amount of power generated will become possible. Apart from their value as a financial undertaking, additions in these respects have become necessary in the interests of the agricultural and economic development of the State.

Need for storage.

6. The Ghat rainfall is unfailing and, unlike the *maidan* tanks in the country, a reservoir on the Cauvery will fill every year.

Special advantage of storage on the Cauvery.

The supply for power generation on the new hydro-electric scheme for Bombay depends mainly on the water stored in the lakes. On the Cauvery, on the other hand, we can double the output of power by storing two months' supply at the present rate, treble the same by storing three months' supply and so on. A small quantity of stored water combined with the substantial, though variable, river flow will do a large amount of work. This is the special advantage of a reservoir on this river or on any similar river having a large perennial flow.

2.—PREVIOUS HISTORY—CAPTAIN DAWES' SCHEME.

7. Although anikats were known from ancient times, it is only within the past 30 or 40 years that attempts have been made to construct high masonry dams across large rivers. Ever since the feasibility of high masonry dams became apparent, the question of constructing a reservoir on the Cauvery has engaged the attention of the successive Chief Engineers of this State. A reservoir would have been built long since, had the principles involved in the building of high masonry dams been so well understood formerly as they are now.

Colonel Sankey, a late Chief Engineer, ordered investigations for an irrigation reservoir project about the year 1870. As a result of the surveys, it was reported that there was only one site for a high dam on the Cauvery, and that was at Ramaswamy Kanave close to the borders of Coorg and Mysore. The cost of a reservoir at this site was considered prohibitive.

About the year 1885 Mr. McLaughlin, Executive Engineer, was placed on special duty by Colonel Bowen, Chief Engineer, to investigate a reservoir scheme for the combined purpose of irrigation and water-supply to the City of Mysore. This project was also abandoned on account of its cost.

In the year 1898, the Mysore Government undertook the construction of a reservoir at Marikanave in the Chitaldrug District at an estimated outlay of Rs. 37 lakhs. As all available funds were required for this undertaking, attention was for a time diverted from the Cauvery project. But since the power scheme came to be installed at Sivasamudram, a reservoir on the Cauvery or on one of its tributaries has become an urgent necessity.

8. Under the orders of Mr. McHutchin, the late Chief Engineer, Mr. V. H. Karve, a former Superintending Engineer, re-investigated the Ramaswamy Kanave site and came to the conclusion that the foundations were unsatisfactory. He then selected two other sites for a dam on the river near Kannambadi, eight and ten miles respectively, west of Seringapatam. The late Captain Bernard Dawes, R.E., who was Deputy Chief Engineer at the time, after careful investigation, recommended the lower site. This site was approved by Mr. McHutchin after Dr. W. F. Smeeth, the present Government Geologist, had examined the foundations and pronounced them to be sound.

Captain Dawes' Scheme.

9. In his final report dated the 25th April 1908, Captain Dawes proposed to construct a reservoir with a dam 70 feet high to be eventually raised to 115 feet. Rough estimates were prepared for the first stage of the scheme. The works comprised therein were :—

		Rs.
(1)	A reservoir to hold 7,000 million cubic feet roughly estimated to cost	40 lakhs.
(2)	An armoured concrete pipe duct with a reservoir and forebay to carry water to the site of the Shimsha Falls (marked B on Plate I)	69 ,,
(3)	Power station and transmission lines	59 ,,
	Total ...	168 ,,

This was for a power supply of 23,000 H.P. including delivery in Madras and Coimbatore. No irrigation was proposed at this stage. An armoured concrete duct carrying 500 cubic feet per second was to start from the reservoir, and end at the Shimsha Falls, distant about 40 miles from the reservoir, and 5 miles measured along the river below the existing power station at Sivasamudram.

10. Captain Dawes' idea was to earn a large revenue by supplying power to Madras and Coimbatore, besides the Kolar Gold Fields, and from the net income so earned to construct a system of canals capable of irrigating 300,000 acres eventually.

In addition to this irrigation, he aimed ultimately to increase the power supply to 70,000 H.P. and the combined scheme of irrigation and power supply was to cost Rs. 440 lakhs.

Captain Dawes summed up his financial forecast in these words :—

"In the 30th year, the original debt will be liquidated, and by the beginning of the 39th year the whole of the irrigation channels will be complete.

"The State will then be the owner of a property free of all charges except Rs. 8 lakhs for maintenance and bringing in a net revenue of Rs. 60 lakhs per annum and this on an original borrowed capital of Rs. 175 lakhs."

Under the advice and guidance of Mr. McHutchin, Captain Dawes worked on these proposals with great zeal and ability; but partly on account of the heavy cost and partly because he contemplated expenditure on works outside the State, the project was not carried to the stage of practical action.

3.—OUTLINES OF COMPLETE SCHEME.

11. It is proposed to construct a storage reservoir on the Cauvery to impound ultimately 41,500 million cubic feet to be utilised partly for irrigation and partly for power supply.

The site at Kannambadi has been selected with a view to get the utmost advantage of the storage for purposes of irrigation. As explained in the Executive Engineer's report, several dam sites were investigated on the main river and on the principal tributaries before finally adopting the one at Kannambadi. A site higher up the Cauvery river will leave out the important tributary stream of Hemavati with about half the catchment above their confluence. A site below the present one, or any site on the Kabani river, will render impossible the irrigation of the arid and drought-stricken level stretch of country between French Rocks and Channapatna on the left bank of the river.

12. The reservoir will be formed by constructing a masonry dam across the main Cauvery river at a point 8 miles west of Seringapatam between the villages of Kannambadi on the left bank and Honghalli on the right. The dam will be founded on a formation of gneiss and hornblende schist as shown on the plans.

Dam site.

Dr. Smeeth, the State Geologist, considers the site "to be an excellent one and there is no doubt that good sound foundations can be secured right across the valley."

13. The complete dam will be 124 feet high above the river bed and 6,300 feet in length. In plan it will present a convex face to the water. The top width will be corbelled out from 12 to 14 feet; the bottom width will be 92·40 feet at the ground level and 114 feet at the foundations in the deepest part. The waste weir will be 2,600 feet long so that the total length of weir and dam will be 8,900 feet.

Dam.

14. *Under-sluices.*—There will be 26 sluices as follows:—

Sluices.

(1) Six sluices measuring each $6' \times 12'$ placed 12 feet above river bed.
(2) Two sluices measuring $4' \times 8'$ each with sills at 40 feet above bed level.
(3) Fifteen sluices each $6' \times 15'$ on the right bank and three sluices of the same size on the left bank, both placed 50 feet above bed level.

Canal sluices.—There will be two sets of sluices, besides one set on the left bank and one on the right, intended for drawing water for irrigation.

15. The waste weir will have its sill at 110 feet above river bed and the maximum depth of flood above weir crest will be 8 feet. The clear height of top of dam above maximum calculated height will be 6 feet.

Waste weir.

Automatic waste weir gates.—The whole of the weir length will be provided with automatic sluice gates similar to those designed by me for the waste weir of Lake Fife near Poona. The gates will be 10 feet wide by 8 feet high and will help to impound water at the end of the monsoon up to the maximum flood level.

This will have the important advantage of adding a depth of 8 feet of water, equivalent to a storage of 8,834 million cubic feet, above weir crest.

16. The total storage capacity of the reservoir up to 118 feet or top level of automatic gates will be 41,500 million cubic feet. As the canal sluices will start at 60 feet above bed of river, a volume of 4,400 million cubic feet impounded below the level will remain unutilised. The net available storage will thus be 37,100 million cubic feet.

Utilising storage.

17. At the full supply level, 27,703 acres will be submerged. Of these, 6,624 acres will be wet cultivation, 650 garden land, 11,208 dry cultivation and 3,128 unculturable waste. Seventeen villages will be submerged partly or wholly and 9,470 persons will be drowned out.

Land submerged.

The total amount of compensation proposed to be paid is Rs. 16,81,440 as explained in the Executive Engineer's report.

The assessment lost to Government will be Rs. 54,174 per annum.

For the first few years after the work is sanctioned, it will be necessary to appoint a special Civil Officer to acquire the land included in the reservoir basin gradually and to make arrangements to provide new land and villages for the population displaced.

As the productive power of the area brought under irrigation will increase by the irrigation facilities provided, the area can support a much larger population than it does at present. The Civil Department would be able to arrange to transfer the displaced population as far as possible either to the canal-irrigated lands or by extending the Mandagiri or other channels nearer their own old habitations.

18. As will be explained in the sequel, it is proposed to utilise the stored water as follows (this is exclusive of the supply drawn from the river direct between 16th June and 31st August):—

Storage.

For irrigation	...	26,307 million cubic feet.
„ power supply in addition to river flow...	...	6,352 „
Supply in reserve, etc.	...	4,421 „
Total	...	37,080 million cubic feet.

19. The cost of the works, as at present contemplated, will be approximately Rs. 253 lakhs as under:—

Cost.

Reservoir	... 139 lakhs.
Canals...	... 106 „
Power development	... 8 „
	253 lakhs.

The estimates under the first and third heads may be taken as final ; that under the second head is approximate and will be subject to revision after the completion of the canal surveys at present in progress. Even under the latter head, enough information is collected to show that there is a much larger area ready to welcome the benefits of irrigation than there will be water for in the reservoir.

20. The results which may be reasonably anticipated in the final stage will be as under:—

Financial results.

5,000 H.P. at Rs. 150 per H.P. (the higher rate will be discontinued from the 11th year after completion of the first stage)	7·5 lakhs.
Irrigation of 150,000 acres at Rs. 6 per acre	9 „
Savings of charges under channels conservancy	·50 „
	17 lakhs.
DEDUCT—	
Working expenses and depreciation	·50 lakh.
Maintenance and working expenses on irrigation at 12 as. per acre...	1·12 „
Loss of revenue on area submerged	·54 „
	2·16 lakhs.

This will give a net increase of revenue of 14·84 lakhs representing a return of 5·86 per cent on a capital of 253 lakhs.

21. In the calculations for the complete scheme, it is assumed that the additional power supplied will not exceed 5,000 H.P. If steps are taken to develop the market for power, a demand for an additional 10 or 15 thousand H.P. is sure to arise and the total revenue will be easily doubled at a capital outlay equivalent to about two years' revenue from the additional power.

The revenue from irrigation is what may be expected in the first few years after the canals are completed; but when high-rated crops gradually replace rice, it is reasonable to look for a return of 5 per cent or more from the share of capital

expended on irrigation. The channels constructed and improved in recent years along the Cauvery are paying 4 to 5 per cent.

On the whole, the estimates of revenue from both irrigation and power supply are conservative. No credit is taken for the higher rates to be obtained in the first ten years, and the estimate for capital includes the sum of 89 lakhs to be expended in the first stage, although, as explained in the sequel, there is every prospect of the latter being repaid together with interest in about fourteen years.

4.—FIRST STAGE OR PARTIAL SCHEME.

22. As the State may not be able all at once to find the money needed for the complete scheme described in the foregoing section, the works will be built by stages and the first instalment will cost Rs. 89 lakhs.

23. In the first stage it is proposed to build the reservoir dam to the height necessary to store water 80 feet deep up to weir crest level. The quantity of water stored will be 11,030 million cubic feet.

Reservoir dam.

Up to a height of 70 feet, the dam will be of the full section necessary for the final stage, that is, for a dam 124 feet high. Between 70 feet level and 97 feet the dam section will be temporary and liable to be removed and, therefore for the sake of economy, it will be made of thinner section as shown on Plate III. The top masonry merely acts as a guard wall to prevent waves from being driven over by the wind in times of extreme high water. The top width at 70 feet will be 34·5 feet and the bottom width will be the same as that for the complete dam already described.

24. The waste weir will be 1,800 feet long with a water way 12 feet high to discharge a maximum flow of about 250,000 cusecs. This provision represents a run-off of ·09 inch from the catchment and is considered very ample. A depth of 12 feet is allowed for flood waterway because the waste weir on the left bank will be temporary. In the design for the complete reservoir dam, the permanent waste weir is located on the right bank.

Waste weir.

25. There will be six under-sluices each measuring 12 ft. × 6 ft. placed at 12 feet above the bed level, and two other sluices placed at 40 feet above the bed level for drawing water for use when the reservoir is fairly full. These eight sluices will be retained for the final scheme. Separate irrigation sluices will not be necessary at this stage.

Sluices.

26. The area submerged in the first stage will be 15,471 acres or 24 square miles made up as under:—

Lands submerged.

Wet land	4,837	acres.
Garden	484	,,
Dry	4,656	,,
Unassessed waste	5,494	,,
Total ...	15,471	acres.

Besides the land, eight villages with a population of 5,020 will have to be removed.

The top 6 feet of land will be available for cultivation although for purposes of the estimate it is marked out for acquisition. A provision amounting to Rs. 10,76,700 is made for compensating the owners of lands and villages.

The annual revenue assessment of the area submerged is Rs. 37,000.

27. If a reservoir is constructed of a smaller section to store 11,000 million cubic feet finally, that is, without the means of raising it at any future time, the quantity of masonry required will be much less. The cost of the reservoir dam in that case (*i.e.*, 80 feet ultimate storage) will be 66½ lakhs (*vide* estimate) or 14½ lakhs less than the estimate recommended for adoption in paragraph 29.

28. The storage will be probably utilised as under:—

For protecting existing power supply	1,300	m. cft.
For additional power supply of 5,000 H.P. ...	3,500	,,
Reserve available for extension of irrigation or power supply ...	6,230	,,
Total ...	11,030	m. cft.

29. The cost of the first stage of the scheme will be :—

Reservoir with 80 feet storage	Rs.	81 lakhs.
Electric power development to generate 3,300 to 5,000 H.P. ...	„	8 „
Total ...	Rs.	89 lakhs.

This is the sum which it is proposed to lay out for the next few years on the scheme. Further developments will be regulated by the returns which this initial outlay may bring, also by the results of the canal surveys now bring carried out and the amount of further capital which Government may be able to provide from time to time.

Financial results.

30. The receipts anticipated from the first stage of the scheme will be as under :—

Increased rate for existing power supply to Kolar Gold Fields at Rs. 30 per H.P. on 10,000 H.P.	Rs.	3 lakhs.
Additional power supply of 5,000 H.P. at Rs. 180 per H.P. ...	„	9 „
Savings in present expenditure on channels conservancy arrangements	„	0·5 „
Total ...	Rs.	12·5 lakhs.

From this amount should be deducted the working expenses amounting to half a lakh and the loss of land revenue from the area submerged amounting to ·37 lakh making a total of ·87 lakh. The net receipts will thus amount to 11·63 lakhs, representing 13·06 per cent on the estimated outlay of 89 lakhs.

The increased rates on present power supply and also on the prospective additions are based on the recent offer of the Mining Companies at the Kolar Gold Fields.

31. It must be remembered that the rates quoted above will apply only to the first ten years after the construction of the reservoir. If an additional outlay of Rs. 16 lakhs is incurred, an area of 25,000 acres can be irrigated by extending the existing channels giving a revenue of 1½ lakhs, or, exclusive of working expenses, a net revenue of Rs. 1,30,000. This represents a return of over 8 per cent on the irrigation outlay. Combined with the results mentioned in the last paragraph, the capital outlay will be 105 lakhs and the net revenue 12·93 lakhs, equivalent to a return of over 12 per cent.

5.—IRRIGATION.

Character of present irrigation.

32. Irrigation as practised within the State at present is either from tanks of which a vast number is dotted over the country or from channels which are nearly all in the Cauvery valley. The total area irrigated from these several sources, in the 29,444 square miles of country comprising the Mysore State, is approximately as under :—

Maidan tanks	500,000	acres.
Malnad tanks	225,000	„
River channels	115,000	„
Total ...	840,000	acres

equivalent to 1,313 square miles or 4·46 per cent of the total area of the country.

The *malnad* irrigation may be considered as safe except occasionally towards the end of the monsoon. The *maidan* tanks play an important part in producing rice and garden crops, but the irrigation from this source is more or less unsafe. In 1876-77, a year of extreme drought, the country suffered much for want of food and about one-fifth of the population of Mysore died from the effects of the famine. The irrigation on the Cauvery channels is more secure, but its area is small. Water is usually available only for the first crop and the irrigation of perennial crops labours under serious disabilities. The hot weather supply is very precarious and crops like sugar cane and mulberry cannot therefore be extensively cultivated.

Perennial irrigation.

33. It is proposed to provide water for irrigation throughout the year; in the monsoon for rice or lighter crops, and throughout the year for perennial crops like sugare cane, mulberry and garden crops. The irrigation proposed under the scheme will be superior to any at present practised on a large scale in any part of the State.

34. It is proposed to construct an irrigation canal starting at a level of 60 feet above the river bed at the dam site. At a point 25 miles from the head works, a hill saddle, known as the Hulikere ridge, has to be crossed. The canal has to be taken across this ridge, partly by means of a tunnel about 2½ miles long, before the canal gains command of a large area of fairly level country. The tunnel will be a costly work. A tunnel of similar length and dimensions is at present under construction at Malakand on the Swat River canal in the Punjab. Beyond its cost the tunnel presents no special engineering difficulties. After crossing the ridge the canal will extend about 50 to 70 miles and command a large tract of country, on both sides of the Railway line. The yearly rainfall in this area is less than 30 inches and some portion of the existing population earn their livelihood by going outside the tract during a part of the year. Even in the mild famine of 1908-09, large numbers of cattle are stated to have died in this tract for want of fodder.

New cannals.

35. It is proposed to irrigate 125,000 acres directly from the canal and 25,000 acres by extending irrigation below existing tanks. There is a large number of these tail tanks in the valley which can be filled with canal water during actual rainfall when water is not required for crops directly dependent on the canal. The tail tanks will retain the leakage and percolation water from the irrigated area.

36. If sufficient water is available, it is proposed also to construct a canal on the right bank commencing at the reservoir dam, taken past the important city of Mysore and ending near the Hulhalli anikat on the Kabani river.

37. If Government are unable to provide the 106½ lakhs needed for the left bank canal within a reasonable time, the irrigation under some of the existing canals like the Chikdevarayasagar and Virjanadi can be extended. As explained in paragraph 31 above, by spending about 16 lakhs on such extensions, an area of 25,000 acres can be brought under irrigation within a year or two.

38. The irrigation to be practised in future will be different from the intensive irrigation to which we were hitherto accustomed under existing canals. It is usual at present in Mysore to irrigate the whole or the greater part of the area commanded by a channel. In future, one-fourth or not more than one-third of any given tract commanded will be placed under irrigation.

Block system.

It is also proposed to concentrate this one-fourth area in separate blocks varying from 60 to 300 acres each and to arrange for a suitable crop rotation as has been done with advantage under the Nira Canal in the Deccan. In this way it is anticipated that the evils of intensive irrigation will be obviated. There will be a keen competition created for utilising the water advantages and the cultivation of high rated crops will receive special encouragement.

39. Irrigation is very well understood in Mysore. People generally resort to rice cultivation wherever there is a supply of water at hand.

Crops.

An attempt will be made to reduce the area under rice as demand arises in favour of other crops like sugar cane which give more value and require less water.

6.—HYDRO-ELECTRIC POWER SUPPLY.

40. The existing works at Sivasamudram are capable of supplying about 13,000 H.P. of which 2,000 H.P. may be considered as reserve and 11,000 H.P. as available for transmission to consumers at the Kolar Gold Fields and the cities of Bangalore and Mysore.

Existing works at Sivasamudram.

The water supply is precarious for two or three months of the hot weather and at present Government have to arrange to make additional supplies available by conserving the water usually given to the existing irrigation channels and by storing temporarily at the several anikats. The storage is effected by raising the anikats by a temporary bank of sand bags and earth. The cost of these works roughly amounts to Rs. 50,000 annually.

41. By constructing a reservoir in the first stage, about 5,000 million cubic feet will be available for power generation and it is proposed to utilise the supply as detailed in paragraph 28

Extension under the first stage.

above. The existing power supply of 11,000 H.P. will be protected and an additional 3,300 H.P. made available immediately. The storage provided will be sufficient to give an additional 8,000 H.P. at Sivasamudram, making a total of 20,000 delivered H.P. If part of the remaining storage is also utilised for additional power supply, about 25,000 H.P. can be developed at Sivasamudram.

Shimsha Falls Power Station.

42. Captain Dawes intended to provide additional supply from the Shimsha Falls instead of from Sivasamudram. The former falls are about 4 miles as the crow flies from the latter. A canal taken along the contour between Sivasamudram and Shimsha will be 11 miles long. Captain Dawes intended to carry water in an armoured concrete pipe duct 40 miles long direct from the new reservoir to Shimsha. It is now proposed to carry the water to Shimsha in a canal taken either from Sivasamudram or from the Mahadeva Mantri anikat in the usual way. In order to develop 15,000 H.P. at Shimsha, an additional outlay of Rs. 30 lakhs will be necessary.

Captain Dawes expected to obtain a clear fall of 720 feet at Shimsha, by the pipe duct arrangement referred to above, at an estimated outlay of 69 lakhs. Under the altered scheme now proposed, the effective fall available will be 622 feet against 382½ feet at Sivasamudram. For every H.P. generated at Sivasamudram, 1·60 H.P. can be generated at Shimsha with practically the same quantity of water.

When any large addition to the power supply is needed, a new station may be started at Shimsha or when the present power plant at Sivasamudram becomes disused, the entire supply may be given from Shimsha.

Market for power.

43. In their letter dated the 21st December 1910, Messrs. John Taylor & Sons have asked for additional power to the extent of 5,000 H.P. in three years and 10,000 H.P. subject to notice being given in the near future. Enough water is provided in the reservoir to generate up to 25,000 H.P. at Sivasamudram, of which about 16,000 including the present 11,000 H.P. will be provided in the first stage of the scheme.

When the same water supply is transferred to Shimsha, 40,000 H.P. will be available at that station. Eventually, including leakage from irrigation or if the river water is utilised for storage after end of August, a supply of 50,000 H.P. can be developed. It behoves the State to encourage industries with a view to utilise this enormous power. Every 1,000 H.P. so utilised will mean not less than a lakh of revenue to Government and perhaps 10 lakhs of manufactured produce to the country.

7.—EFFECT ON IRRIGATION IN MADRAS PRESIDENCY.

Time chosen for filling reservoir.

44. On account of the intermittent character of the river discharge, it is proposed to store the entire supply required for the Mysore reservoir during the first 2½ months of the monsoon, *viz.*, between 16th June and 31st August. During these months it is always possible to fill the reservoir. With fairly good rainfall, the reservoir may usually fill before the end of July.

45. But the reservoir can be always kept partly full at the beginning of the monsoon from the surplus flow of the river between February and 15th June because in that period water is not required for irrigation in the Madras Presidency. Again during the north-east monsoon there will be intervals in which the rainfall below the Mysore reservoir will be sufficient for the delta irrigation. Some storage can be looked for at this time also. Although it is calculated that the reservoir will fill entirely during the monsoon, there is every prospect of replenishments both before and after the period of 2½ months named above. In these circumstances, it would be safe to assume that the supply for the reservoir will not fail in any year.

46. It must be remarked that irrigated land to the extent of 5,321 acres in the first stage and 7,274 acres in the final stage will be submerged by the reservoir and thrown out of cultivation. The water set free amounting to between 2,000 and 3,000 million cubic feet will be added to the present supply of the river. It may also be remarked that, in the event of Madras constructing a reservoir, the present variable flow at the Cauvery dam will be changed into a uniform flow. When this is done, the storage required for crops below the Cauvery dam in the irrigation season

will be only about 190,050 million cubic feet and the surplus supply availabe for storage will be 235,505 million cubic feet.

The correct figures are :—

(1)	Average discharge at the Cauvery dam for 20 years ended 1909-10 ...	425,555 m. cft.
(2)	Average quantity actually used for delta irrigation in the same period...	294,084 ,,
(3)	Average surplus which went to waste	131,471 ,,
(4)	Average annual surplus available if regulated as proposed in Madras Cauvery project	235,505 ,,
(5)	Quantity required to be withdrawn from river for irrigation in Mysore, about	40,000 ,,

It will thus be seen that the supply required in future is less than one-third of the average supply which ran to waste within the past 20 years and about one-sixth of the surplus available if regulated as proposed in the Madras Cauvery project.

Catchment area and discharges.

47. The catchment area of the river above the proposed Mysore reservoir is 4,100 square miles. The total catchment area in and above Mysore is 13,091 square miles and the corresponding catchment area above the Cauvery dam at the head of the delta 26,172 square miles.

The total discharge of the year at the Cauvery dam is reckoned at 425,000 million cubic feet; that at the Sivasamudram Falls as over 300,000 and at the Kannambadi site probably 220,000.

The area irrigated at present in the delta below the Cauvery dam is 1,065,000 acres and that in Mysore, as already stated, 108,000 acres. The irrigation actually practised in Mysore is therefore less than one-ninth of that in British Territory, while the river as it leaves Mysore contributes about three-fourths of the total annual discharge of the river. Whether regard be had to the catchment area within, or the actual discharge through, the State, it is clear that Mysore has the first claim to the surplus water of the river.

48. As, however, the Madras Government have themselves prepared a reservoir project to store 80,000 million cubic feet and to irrigate an additional area of 330,000 acres, there can be no objection to Mysore constructing a reservoir of half the capacity or providing for new irrigation to the extent of about one-half of that proposed in Madras. All the more so, because the Madras reservoir is intended to be constructed only 61 miles below the Mysore boundary and, admittedly, nearly all the storage required for it will be derived from Mysore.

8—REMARKS ON THE PRINCIPAL FEATURES OF DESIGN.

Dam profile.

49. The section of the dam has been determined by trial calculations as in the case of similar designs prepared by me elsewhere.

The weight of the masonry is taken at 145·8 lbs. per cubic foot after experiment, as explained in the Executive Engineer's report.

Calculations have been made for a slice of masonry wall one foot in length and of the full section, the slice being regarded as standing without lateral support. The section fulfils all the conditions of strength and stability considered essential and is the most economical for the given conditions.

50. The maximum stress on the outer face with reservoir full is 6·11 tons per square foot. Taking the obliquity of pressures into account on M. Bouvier's principle, the maximum stress at a depth of 120 feet below dam crest on the downstream face amounts to 8·30 tons per square foot. For comparison, it may be mentioned that the corresponding maximum stress on the Periyar dam was 9 tons and the Bhatgarh dam (Lake Whiting) 9·57 tons.

The co-efficient of friction to prevent sliding is ·604. The factor of safety in the deepest section against overturning is 2·70, the minimum usually considered sufficient being 2.

Supply from the catchment basin.

51. The Executive Engineer's report and appendices will show that the questions of rainfall and yield from the catchment basin have been very exhaustively gone into. The conclusion is that the river on an average discharges between 200,000 and 250,000 million cubic feet per annum past the Kannambadi site.

52. The maximum flood is fixed at 250,000 cusecs after very careful observations of floods and flood marks. The allowance is considered very liberal and absolutely safe.

Maximum flood.

53. The under-sluices proposed will help to keep out silt from the reservoir basin to a reasonable extent and no special provision for dredging, such as was originally contemplated, is considered necessary.

Silt.

54. The principal features of the reservoir in its first stage and when fully completed, respectively, are compared in the following table :—

Abstract of principal features.

Particulars		First stage	Final stage
Catchment area	Square miles ...	4,100	
Estimated average annual rainfall over the entire catchment	Inches ...	60·63	
Malnad (Ghat) catchment	Square miles ...	1,881	
Average malnad rainfall per annum ...	Inches ...	96·63	
Maidan catchment	Square miles ...	2,219	
Average maidan rainfall per annum ...	Inches ...	30·11	Same as in first stage.
Total yield from catchment	Mill. cub. feet ...	220,000	
Maximum estimated discharge at the dam site	Cusecs ...	250,000	
Run-off from catchment due to estimated maximum flood	Inches ...	.09	
Capacity of reservoir up to full supply level...	Mill. cub. feet ...	11,037	41,500
Length of dam	Feet ...	4,200	6,300
Maximum height of dam above bed ...	„ ...	97	124
Maximum height of dam above foundations	„ ...	116	143
Length of waste weir	„ ...	1,800	2,600
Estimated depth of maximum flood ...	„ ...	12	8
Total cost of Reservoir	Rupees ...	81 lakhs	139 lakhs
Cost per million cubic feet stored ...	„ ...	736	335

9—COMPARISON WITH OTHER RESERVOIR PROJECTS.

55. A few words at this stage may not be out of place to explain how the Cauvery Reservoir when constructed will compare with some of the large reservoirs already constructed in India. The principal Indian reservoirs are the Periyar in the Madras Presidency, the Marikanave in the Mysore State, Lake Whiting at Bhatgarh which supplies the Nira Canal in the Bombay Presidency, the Tansa reservoir which is the principal source of water-supply to the Bombay City and Lake Fife near Poona.

Reservoirs formed by high masonry dams.

56. As contemplated in respect of the Kannambadi reservoir, the Tansa dam is built with a wider section than is necessary for its present height with a view to raising it at some future time to increase the storage.

In the case of the Periyar reservoir, the storage actually utilised is 30,000 million cubic feet, although the available storage is 6,815 million cubic feet only. In the case of the Kannambadi reservoir likewise, the quantity used for power supply and irrigation together including the natural flow of the river, will be about 68,000 million cubic feet although that used for irrigation only will be less than 40,000 million cubic feet and the available storage with reservoir full will be 37,100 million cubic feet.

57. The maximum height of the proposed Cauvery dam measured from the foundations will be 143 feet, the corresponding height of the Periyar dam is 173 feet, of Marikanave dam 167 feet, of Tansa 118 feet, and of the Assuan dam in Egypt (when completed) 130 feet.

The quantity of masonry in the Kannambadi dam will be 22·2 million cubic feet; that in the Marikanave dam was 8 million cubic feet, the Periyar 6 million cubic feet, Lake Whiting 4·7 million cubic feet, Assuan dam in Egypt (before it was raised) 19 million cubic feet.

58. The total storage capacity of the Kannambadi reservoir will be 41,500 million cubic feet, that of the Marikanave 30,145 million cubic feet, of Periyar 6,815 million cubic feet, of Lake Whiting 5,313 million cubic feet, and of Assuan before it was raised 38,000 million cubic feet. The capacity of the latter when raised to the full proposed height will be 81,000 million cubic feet.

Storage capacity and cost per million cubic feet.

In the case of the Kannambadi reservoir, the cost per million cubic feet stored will be Rs. 736 in the first stage and, when completed Rs. 335, showing that the larger the size of a lake, the cheaper will be the rate per unit stored. This is one of the reasons why a large reservoir is recommended. The corresponding rate per million cubic feet for Periyar lake was Rs. 653.

59. As the Marikanave reservoir has not been a financial success, doubts may be raised as to whether the Cauvery reservoir may not share the same fate. The conditions of the two reservoirs are, however, very different. The Marikanave reservoir is an expensive work because a dam much higher than is usually constructed in such cases was necessary on account of the peculiar conditions of the site. The Marikanave is dependent on an extremely dry tract for its gathering ground and the collection of water is intercepted by no less than 970 tanks. The supply received in the lake has fallen short of the original expectations. The river Vedavati loses itself in the lake; the large capacity of the latter gives it no chance of a direct flow past the lake. The source of supply of the Cauvery on the other hand is from a Ghat region with an unfailing rainfall. The land along the Cauvery valley is well suited for irrigation and no opportunity of utilising water for the purpose is ever missed. The country below the Marikanave reservoir is formed of black soil not considered favourable for irrigation.

Comparison with Marikanave reservoir.

There is every reason to expect that the expenditure on the Cauvery reservoir will prove a very remunerative investment, whereas the Marikanave scheme has from the first been regarded merely as a useful protective work. Col. McNeil Campbell, the Chief Engineer, who started the work, did not expect it to prove a financial success. "I have some doubts as to the project being remunerative" was the remark with which he concluded a report on the scheme so long ago as 1899.

10.—CONCLUSION.

60. The final surveys and the preparation of the project were commenced in the month of July 1910 with the approval and under the orders of Mr. T. Ananda Row, C.I.E., Dewan, and the sanction of His Highness the Maharaja of Mysore.

The estimates for the hydro-electric portion of the scheme have been kindly furnished by Mr. H. P. Gibbs, M.I.E.E., Chief Electrical Engineer to Government, who has for several years been in charge of the Cauvery Power Scheme and whose knowledge of similar schemes in other parts of the world is unrivalled. The reservoir project has received energetic and capable treatment at the hands of Mr. B. Subba Rao, L.C.E., Executive Engineer (and sometime Officiating Superintending Engineer) assisted by Messrs. M. A. Anandalwar, B.A., B.C.E., and K. R. Seshachar, B.A., B.E., Assistant Engineers. The last-named officer was for many years employed on the Marikanave dam. The rates for the work are based partly on his personal experience on that great dam.

61. Enough has been said to show that, for any new departure from the existing methods of irrigation and power supply, the construction of a large reservoir is an indispensable preliminary. Although the *maidan* tanks have their own value, money spent on this irrigation scheme will confer far more lasting benefits on the State. The reservoir will fill both in good years and in bad from the unfailing supply of the ghats and irrigation will be practised throughout the year. As a constant supply will afford an opportunity of growing high rated perennial crops like sugar cane, the agricultural value of the land will greatly gain in value.

In the first stage, provision is made only for protecting the old irrigation. But enough storage will be held in reserve for an immediate extension by 25,000 acres as soon as the necessary funds (estimated at Rs. 16 lakhs) are forthcoming. Later on, this can be increased to about 150,000 acres capable of yielding about 8 lakhs of net revenue to Government and 1¼ to 1½ crores of irrigated produce to the people.

62. The power supply has come to stay. As remarked by the late Resident, the Hon'ble Mr. S. M. Fraser, "in the electricity generating powers of the Cauvery Falls, the State possesses a national asset equivalent to a perpetual coal mine." The power generated is already utilised for lighting and other purposes in the cities of Bangalore and Mysore and its more extended use for industrial purposes is a question of time. Besides gold mining, power can be used for working railways, smelting iron and other ores, cotton and silk industries, manufacture of nitrates for manure, lighting towns, pumping water, lift irrigation, cottage industries, etc. The existing power supply of 11,000 H.P. will be protected; an addition of about 5,000 H.P. will be made available immediately and 20, 30 or 40 thousand H.P. eventually.

63. In Western countries like Switzerland and Sweden where the necessary facilities exist, they have made immense strides in developing electric power. I had occasion to make enquiries in Switzerland towards the end of 1908 into this subject. The Secretary to the Chamber of Commerce at Zurich informed me that the aim of their Government was to utilise their waterfalls and dispense with the necessity of importing coal. Herr T. Peter, Chief Engineer of the same city, gave more particulars. The total motive power used in the country according to him was 300,000 to 400,000 H.P. Of that, 100,000 H.P. was generated by steam; the rest was from waterfalls. When the installations, then being developed, were all completed, they would get a total of 800,000 H.P.

These statements are quoted to indicate the spirit in which the question of water power development is viewed in other progressive countries.

64. If the partial scheme or the first stage of the work is completed, the protection which the Mining Companies desire will be provided. An additional supply up to 10,000 H.P. also asked for by them will be available; the hot weather supply to the canals which has hitherto been stinted will be restored; extension of perennial crops on existing canals will be encouraged; the expenditure of about half a lakh incurred annually for temporary storage of river water will be saved; and the capital together with charges for interest will be repaid in about 12 years from the date the work begins to yield the full calculated revenue. The Gold Mines will also prosper; but, after they cease work, as one day they must, the masonry reservoir will remain a permanent asset to the State. It can be used for power generation or irrigation according to the prospects of revenue. If the demand for power supply be slack, irrigation may be extended and *vice versa*. The developments will be in whichever direction the balance of advantages may lie.

Results anticipated from the first stage.

65. A return of 12½ per cent would be satisfactory even in undertakings of a speculative character. According to all accepted standards of productive undertakings, the reservoir scheme even in the first stage is a work of great promise. Whatever developments are carried out from time to time should form part of a comprehensive scheme. Such a scheme in its outline is now submitted and, for the first stage of the work, we have detailed plans and estimates ready to enable Government to commence operations at any moment.

Once commenced, the scheme opens up a vista of possibilities of ever increasing value to the State. But the speed with which developments take place will not be spontaneous but must depend entirely on the energy and foresight displayed by the responsible Government in improving the market for power and extending irrigation. Having regard to the indirect revenue to the State by the increase in the productive power of the country, a work like this would be justified even if it paid no more than 3 per cent. But the promise of extraordinary direct returns from power supply at commencement, and the opportunity it affords of building up a great irrigation project from the sale proceeds of power, form a combination of advantages rarely vouchsafed to such undertakings in any part of the world.

M. VISVESVARAYA, M.I.C.E.,
Chief Engineer of Mysore,
Public Works Department.

BANGALORE,
5th May 1911.

ABSTRACT ESTIMATE No. I.

CAUVERY RESERVOIR PROJECT.

First Stage—Storage 80 feet.

Particulars	Cost
	Rs.
Constructing a Reservoir across the River Cauvery at Kannambadi ...	81,00,000
Installing additional Power Plant at Sivasamudram	8,00,000
Total ...	89,00,000

RESERVOIR.

First Stage—Storage 80 feet.

Quantity	Description of work	Rate	Amount
1	2	3	4
	PRELIMINARY.	Rs. a. p.	Rs.
	Preliminary expenses	.....	1,00,000
	LAND.		
5,256	Wet land	160 0 0 Acre ...	8,40,960
4,408	Dry land	25 0 0 Do ...	1,10,200
721	Tiled houses	80 0 0 Each ...	57,680
233	Thatched houses	20 0 0 Do ...	4,660
2	Constructing Kannambadi temples ...	1,500 0 0 Do ...	3,000
11	Compensation for temples	200 0 0 Do ...	2,200
2,300	Constructing a new bridge across the Lakshmanatirtha river.	20 0 0 Sq. ft. of waterway.	46,000
8	Diversion of roads	1,500 0 0 Mile ...	12,000
			10,76,700
	WORKS.		
	Construction of main dam.		
	Clearing and unwatering foundations ...	.....	1,89,222
1,29,932	Excavation in hard rock	1 8 0 C. yd....	1,94,898
1,25,022	Do in soft rock	0 12 0 Do ...	93,766
62,511	Do in very soft rock and gravel ...	0 4 0 Do ...	15,628
4,078	Washing foundations, grouting cracks and cavities with liquid cement.	6 0 0 Sq.	24,468
	Choking big springs	Lump sum ...	5,000
1,65,388	Cement concrete below foundations ...	0 14 6 C. ft. ...	1,49,883
15,152,270	Rubble masonry	24 0 0 100 C.ft.	36,36,545
40,000	Filling foundation trenches in front of dam with clay puddle.	0 4 0 C. yd. ...	10,000
3,470	Cement pointing	6 0 0 Sq. ...	20,820
			43,40,230
	Sluices.		
8	Scouring sluices, 6 vents of 6′ × 12′ each, in river bed and two vents of 4′ × 8′ each, on the right and left banks.	.....	3,80,292

RESERVOIR—*contd.*

Quantity	Description of work	Rate	Amount
1	2	3	4
	Waste weir.	Rs. a. p.	Rs.
7,85,507	Excavation	0 10 0 C. yd....	4,90,942
	Training walls	Lump sum ...	29,058
	Bridge over weir	Do ...	30,000
	Protective works	Do ...	1,00,000
			6,50,000
	BUILDINGS.		
	Offices.		
1	Public office	.....	6,000
1	Police lines	.....	2,000
1	Post office	.....	1,500
1	School	....	1,500
	Work Buildings.		
	Stores, workshops, cement sheds, machine sheds, testing sheds, magazines, etc.	.....	18,000
	Quarters for Staff.		
20	Officers and Upper Subordinates	.....	26,900
79	Clerks, Draftsmen and Sub-Overseers ...	.....	33,100
150	Peons, servants, fitters and drivers ...	.....	3,900
40	Temporary maistries	.....	1,200
1	First Class Inspection Lodge	.....	9,000
1	Hospital with in-patient wards	.....	6,900
	Repairs during construction	.....	10,000
			1,20,000
	MISCELLANEOUS.		
	Opening out roads	Lump sum ...	5,000
	Arranging places for bazaars and *santhes* ...	Do ...	2,000
			7,000
	Water-supply.		
	Fitting up pumps	Lump sum ...	5,000
	Storage reservoir	Do ...	5,000
	Filter	Do ...	4,000
	Distribution pipes	Do ...	8,000
54	Maintenance	100 0 0 month ...	5,400
			27,400
	Temporary bridges, boats, etc.	Lump sum ...	10,000
	Protective works for temporary weir during construction.	Do ...	20,000
	Repairs to dam during construction ...	Do ...	10,000
54	Medicine and sanitation	700 0 0 month...	37,800
	Unforeseen charges	Lump sum ...	1,00,000
			2,12,200
			68,79,422
	Contingencies at 5 per cent	.....	3,43,971
	Total ...		72,23,393
	ESTABLISHMENT CHARGES	.....	6,51,637
	TOOLS AND PLANT	Lump sum ...	2,00,000
	Grand Total ...		80,75,030 or 81 lakhs.

ABSTRACT ESTIMATE No. II.

CAUVERY RESERVOIR PROJECT.

Final Stage—Storage 118 feet.

Particulars	Cost
	Rs.
Constructing a Reservoir across the River Cauvery at Kannambadi ...	1,39,00,000
Installing additional Power Plant at Sivasamudram	8,00,000
Constructing Canal Works (approximate)	1,06,00,000
Total ...	2,53,00,000

RESERVOIR.

Final Stage—Storage 118 feet.

Quantities	Description of work	Rate	Cost
1	2	3	4
	Preliminary		1,00,000
	LAND.		
	Land compensation.		
18,482	Wet and dry lands	80 0 0 Acre ...	14,78,560
1,284	Tiled and mud-roofed houses	80 0 0 Each ...	1,02,720
473	Thatched houses	20 0 0 Do ...	9,460
2	Removing Kannambadi temples	Lump sum ...	3,000
21	Do other temples	200 0 20 Each ...	4,200
2,300	Constructing a new bridge across the river Lakshmanatirtha	20 0 0 Sq. ft....	46,000
25	Diversion of roads	1,500 0 0 Mile ...	37,500
			16,81,440
	WORKS.		
	Construction of main dam.		
	Clearing and unwatering foundations ...	.....	1,89,223
1,53,599	Excavation in hard rock	1 8 0 C. yd. ...	2,30,399
1,72,356	Do in moderately soft rock ...	0 12 0 Do ...	1,29,267
86,178	Do in very soft rock	0 4 0 Do ...	21,544
5,503	Washing foundations, etc.	6 0 0 Sq. ...	31,018
	Choking big springs	Lump sum ...	5,000
1,79,218	Cement concrete below foundations ...	0 14 6 C. ft. ...	1,62,416
211,12,397	Rubble masonry	24 0 0 100 C. ft.	50,66,975
85,063	Extra cost for flooring on top of dam with irregular roughly dressed granite stone ...	0 3 0 Sq. ft....	15,949
5,289	Cement pointing	6 0 0 Sq. ...	31,734
40,000	Filling foundation trenches in front of dam with puddle	0 4 0 C. yd. ...	10,000
	Parapet wall or railings for sides of dam up to commencement of weir	Lump sum ...	20,000
			59,13,525

RESERVOIR—*contd.*

Quantities	Description of work	Rate	Cost
1	2	3	4
	Sluices.	Rs. a. p.	Rs.
1	Irrigation sluices, Right bank	.....	59,595
3	Do Left bank	.....	1,42,337
6	Scouring sluices 6′ × 12′	.....	3,20,534
2	Do 4′ × 8′ one on each bank ...	.....	69,610
15	Do 6′ × 15′ Right bank ...	.....	8,71,570
3	Do 6′ × 15′ Left bank ...	.....	1,89,827
			16,53,493
	Waste weir.		
3,43,718	Excavation	0 10 0 C. yd ...	2,14,824
	Training walls	Lump sum ...	30,000
	Bridge over weir	Do ...	50,000
	Protective works below weir	Do ...	3,00,000
	Expenditure incurred for temporary weir at 80 feet.	.....	6,50,000
			12,44,824
	Automatic shutters	.....	10,00,000
			98,11,842
	BUILDINGS.		
	Offices.		
1	Public office	.....	6,000
1	Police lines	.....	2,000
1	Post office	.....	1,500
1	School	.....	1,500
	Work buildings.		11,000
	Stores, Workshops, Cement sheds, Machine sheds, Testing sheds, Magazines, etc.	.....	18,000
	Quarters.		
20	Officers and Upper Subordinates	.....	26,900
79	Clerks, Draftsmen and Sub-Overseers ...	.....	33,100
150	Peons, servants, fitters and drivers ...	.....	3,900
40	Temporary maistries	.....	1,200
			65,000
1	First Class Inspection Lodge	.....	9,000
1	Hospital with in-patient wards	.....	6,900
	Repairs during construction	.....	10,000
	MISCELLANEOUS.		1,20,000
	Opening out road	Lump sum ...	5,000
	Arranging places for bazaars and *santhes* ...	.....	2,000
	Water-supply.		7,000
	Fitting up pumps	.....	5,000
	Storage reservoir	.....	5,000
	Filter	.....	4,000
	Distribution pipes	.....	8,000
84	Maintenance	100 0 0 month...	8,400
			30,000

RESERVOIR—*concld.*

Quantities	Description of work	Rate	Cost
1	2	3	4
		Rs. a. p.	Rs.
	Temporary bridge, boats, etc.	.....	10,000
	Protective works for temporary weir during construction.	.....	20,000
	Repairs during construction	.....	10,000
84	Medicine and Sanitation	700 0 0 month...	58,800
	Unforeseen charges	.....	1,00,000
			1,98,800
			119,49,482
	Contingencies at 5 per cent	... ..	5,97,474
	Total ...		125,46,956
	ESTABLISHMENT CHARGES	.....	10,13,657
	TOOLS AND PLANT	.....	3,00,000
	Grand Total ...		138,60,613 or 139 lakhs.

NOTE 1.—Government conveyed administrative sanction to the construction of the first stage of the Reservoir and the Fourth Installation of the Cauvery Power Scheme in their Proceedings C. No. 13-19—84-90, dated Camp Mysore, 12th October 1912 (*vide* page 61

2.—The detailed estimates for the first stage of the Reservoir Scheme which were submitted to Government with the Public Works Secretary's Note dated the 30th April 1912, were formally sanctioned in Proceedings No. 1027-33 A—6586-92 A, dated Bangalore, 7th August 1912 (*vide* page 62.

RESERVOIR SECTION

Report dated the 3rd April 1911, by Mr. B. Subba Rao, L.C.E., Executive Engineer, to accompany the Cauvery Reservoir Project.

SECTION 1.

Reference.

The necessity for providing additional storage in the Cauvery Valley having been recognised, the Government, in their Proceedings No. 653-65—6186-98, dated the 6th June 1910, have directed the preparation of a project for constructing a storage reservoir and sanctioned the formation of a Survey Division for this purpose. The files on the subject are full; only the salient points connected with the project are touched upon in this report. The recently printed records of the scheme, as worked out by Captain Dawes, R.E., the late Deputy Chief Engineer, contain full information on it up to the stage advanced by him. The scheme, as finally developed by him, provided for (*a*) the construction of a reservoir to store 7,000 m. cft. of water, (*b*) the installation of power plant to generate power to a large extent on the Shimsha River Bank, a little below the falls in it—these falls are 236 feet greater in depth than the Cauvery Falls at Sivasamudram (thus making it possible to generate more power at the Shimsha than at the other place with the same quantity of water to work the turbines)—and (*c*) for other necessary works including a covered duct to convey water from the reservoir to work the turbines of the power plant. The question of irrigation was proposed to be taken up later on to be carried out with the money derived from the sale of power. This scheme was ordered to lie over. The difficulty from insufficiency of supplies in the summer months still continuing, the matter has again to be considered.

Object of constructing the reservoir.

II. It is proposed to construct a reservoir across the Cauvery river to store a portion of the floods during the south-west monsoon with the object of (1) maintaining the requisite minimum flow in the river in summer for working the turbines of the power plant at the Cauvery Falls, Sivasamudram, (2) protecting the hot weather crops under the river channels and tanks fed by them and (3) extending irrigation in the tracts subject to drought to the north of the river.

Present conditions.

III. At present Electrical Power to the extent of 10,000 H.P. is being generated at Sivasamudram. This power is mostly transmitted to the Kolar Gold Fields and used there for working the compressors, stamp mill batteries, hoists, pumps and other machinery employed for extracting and crushing the ore; small quantities of power are transmitted to the Bangalore and Mysore Cities for industrial and lighting purposes and to Belagola, near Seringapatam, for working the pumps of the Vani Vilas Water Works of the Mysore City.

(1) The supplies in the river at Sivasamudram are amply sufficient for working the turbines during the months, June to January; but, in the dry weather, difficulty is experienced in maintaining the requisite flow to work the machinery. The total monthly discharges vary from an average of 134,052 m.cft. for July to 1504 m.cft. during April. Some early showers—which are, however, not dependable—cause freshes in the river in April and May; in June, the south-west monsoon commences and there is a steady flow in the river until the maximum is reached in July and August, after which the flow gradually falls down. This is seen from a diagram enclosed. To save loss of revenue from short supplies in the dry weather to develop the power required, temporary arrangements for additional storage are being made at certain anikats and tanks for the last two years. These operations have been more or less successful; but they cost about Rs. 50,000 a year and there is always some amount of risk attached to them. A statement showing the periods during which there was shortage of water for power generation, the amounts of rebate that had to be allowed and the cost of the operations for conservancy of river supplies during the last two years, is enclosed (Appendix A.) * It is evident that, under existing canditions, demands for extra power cannot be complied with, though there is ample supply in the river for about eight months in the year.

* Not printed.

At present, there is an urgent demand from the Kolar Gold Mining Board for 5,000 additional H.P. immediately and for 5,000 H.P. more to be given at an early date.

(2) The hot weather crops under the river channels and tanks fed by them are confined to small patches and further suffer from insufficient supplies. Under these river channels, only one crop—rice mostly—is grown on about 110,000 acres between June and January; the extent of gardens is small and the valuable sugar cane and other crops do not exceed 1,500 acres. It is not possible without additional storage to extend the growth of these valuable crops and to raise mulberry and manurial crops to enrich the impoverished soil. There is considerable demand from our agricultural population for additional supplies for these purposes.

(3) The country in the central part of the Mysore plateau—to the north of the Cauvery river—comprising the taluks of Mandya, Malvalli, Nagamangala, Kunigal and Channapatna, among others, is subject to failure of seasonal rains, resulting in loss of crops to a larger or smaller extent. The rainfall varies from 26 to 30 in. per annum. The wet cultivation is especially precarious; there are numerous tanks, but they do not generally fill; the major streams draining this tract—Lokapavani, Shimsha, Kanva— having their sources in the dry plateau, are not perennial and, even during the monsoons (which become weaker as they proceed further to east of the Western Ghats), they do not flow for sufficiently long periods to be made use of to any appreciable extent for irrigation purposes. The tract is healthy and the population averages 202 per sq. mile; but, owing to uncertainty of rains, a good number of the poorer classes of the people of these parts migrate annually to Malnad-Wynaad, Coorg, Manjarabad, Mudgere, etc., to eke-out a living on the coffee estates and paddy fields and on Public Works. They return to their villages for a few months each time to recruit their health and then go back to Malnad. This dry tract suffered very badly in the famine of 1876-77 when about $\frac{1}{5}$th of the population was starved to death and even in the comparatively mild drought of 1908-09, there was much distress and loss of cattle, due to want of fodder and the drying up of drinking water sources. In years of drought in the plateau, herds of cattle are driven to Malnad for grazing purposes. The Cauvery is a perennial stream taking its source in the Western Ghats and, when once the south-west monsoon has set in, about the middle of June, there is a steady rise in flow till end of July; this flood continues more or less throughout August. (The flow gradually decreases, but in October and November the rains of the north-east monsoon contribute supplies to some extent. The flow then falls down rapidly till it reaches the minimum in April). These floods, excluding the portions drawn for irrigation in the Mysore State and in the Madras Districts along the Cauvery, discharge themselves into the Bay of Bengal. The average yearly discharge, at the upper anikat at the head of the Delta, is estimated at 430,000 m. cft. to 600,000 m.cft. Out of this, about 200,000 m.cft are utilised for irrigation; the rest goes to sea as surplus. If a portion of these surplus floods of the monsoons can be arrested and delivered on to the thirsting plains in the Mysore plateau noted above, the present state of affairs is sure to improve; a great boon will be conferred on the raiyat population and the State is certain to reap its share of the prosperity, both directly and indirectly. The reservoir now under consideration proposes to do this.

Question of site.

IV. All possible sites for constructing storage reservoirs on the Cauvery and its affluents capable of serving the above purposes were examined and about 30 sites were investigated in greater detail. Most of these had to be rejected owing to unsuitable soil for foundations, want of proper sites for weirs, submersion of valuable lands or insufficient storage capacity. Among the rest are several good sites for anikats but as sufficient supplies cannot, under present conditions, be assured after the south-west monsoon even for the small extent of lands commanded by the existing channels, there is no use of increasing the number of these anikats without first providing for storage or increasing the duty of water. (The Memoranda on the subject are full and copies are enclosed as Appendix B.)*

Situation of selected site.

(*a*) Of the remaining sites, the one across the main river at North Latitude 12° 33′ 20″ and East Longitude 76° 37′ 15″ (*vide* Topo Sheet No. 57) about 8 miles to west of Seringapatam and close to the village of Kannambadi, is found to be most

* Not printed.

suitable for constructing a large reservoir. The river bed here is narrow, about 900 feet in width, and rock extends throughout the bed. The banks rise rapidly up to small hillocks on each bank. The site is easily reached from the village of Belagola on the Madras-Cannanore road by a small District Fund road up to Balmuri on the Cauvery and thence by a cart-track two miles in length along the bank of the river. On the north bank of the river, the Lingaraja Chattar-Kalhalli road runs for about 1½ miles from the site. The papers enclosed refer to the construction of a storage reservoir here. This is the site referred to in Captain Dawes' Scheme.

Another site, two miles higher up the river and called the Kannambadi upper site, was also examined; but it was given up as the rock met with is less favourable than at the lower site. The bed-width is also considerably greater at this upper site which would add to cost if that site were selected.

SECTION 2.

V. The catchment area of the river at the selected site is 4,100 square miles. The main river rises at Tala-Cauvery, 20 miles to south-west of Mercara, and after a course of 50 miles in Coorg, enters Mysore near the town of Fraserpet. It runs for about 150 miles in the Province, generally in a south-easterly direction and then forms for about 30 miles from Sivasamudram to the junction of the Arkavati the boundary between the Mysore State and the Madras Districts. It receives, above the site noted above, the Hemavati and Lakshmanatirtha, both having their sources as the main river itself, in the Western Ghats. This Malnad portion of the catchment is hilly and thickly wooded and has a much heavier rate of rainfall mostly in the south-west monsoon than the Maidan portions, the rains averaging for a series of years to about 96·63 inches in the Malnad and to 30·11 inches in the Maidan. (The enclosure Appendix C* gives full information on the subject.) Rains never fail in the Malnad, more or less heavy floods being carried down steadily in the river from the middle of June to the beginning of October, even in years when rains fail elsewhere. The north-east monsoon also gives some rains; but their effect on the catchment is unimportant, as they are not of a steady nature.

Catchment and rainfall.

VI. From observations of discharges at some of the anikats across the main river and its tributaries and consideration of rainfall over the catchment and run-offs, the average total discharge per annum, at the proposed dam site, for a series of years, is found to be about 250,000 m.cft. per annum. Appendix D* enclosed treats of the discharges in the river, the run-off factors and results derived therefrom. The major portion of the discharge is confined to the months of June to October, while between January and May the flow is insignificant.

Supplies.

VII. The question of flood discharges in the river has received careful attention. Records of gauge readings at certain places on the river are available for a series of years. Run-offs at the selected site have been calculated on the results of these records and on calculations based on them. These have been checked (1) with the quantities as arrived at by the application of the several formulæ usually employed in this connection, (2) with the quantities arrived at from the cross sectional method, taking the maximum high-flood levels and surface fall of floods into consideration and (3) by comparison with maximum discharges at the bridges on the Cauvery at Seringapatam, a few miles below the site. The maximum flood discharge at the dam site amounts to about 250,000 cft. per second; the ordinary high floods are a good deal below this. (Appendix E* accompaying deals fully with the subject.) These high floods occur generally in the months of July and August. The effect of rains in the north-east monsoon on the river supply is comparatively insignificant and short in duration.

Flood discharges.

VIII. It is proposed to store in the reservoir 41,500 m.cft. (or 158,700 local units, each unit being about 260,000 cft).

Storage capacity.

(*a*) The scheme provides for a dam being built for this purpose in two stages; in the first stage, the work will be limited to what is needed to allow floods to surplus at 80 ft. above bed of river, the storage capacity at this level being 11,030 m.cft.

*Not printed.

(*b*) In the second or final stage of the work, the dam will be raised to full height, with weir 110 ft. above bed; as floods subside, the storage will rise by means of automatic shutters to be fixed on crest of the masonry weir to 118 ft. above bed. The capacity at this level is 41,500 m.cft. The capacities of the reservoir for every foot in height, from 35 to 130 feet, above bed, will be found in Appendix F. A diagram also shows these graphically.

SECTION 3.

IX. (*a*) The proposals of the complete project are—

Construction proposals.

(1) Constructing a dam 124 ft. high above bed.

(2) A masonry weir for the greater portion of the floods to surplus at 110 ft. above bed; automatic shutters will be fixed, eventually, on crest of this weir to store water at the tail end of the rainy season to 118 ft. on bed.

(3) Building under-sluices in dam to dispose of silt and a portion of the flood discharges. There will be 26 of these.

(4) Building an irrigation sluice on the left bank of the river to regulate supplies into the canal for irrigating lands in the dry tract to north of the Cauvery.

(5) Buliding an irrigation sluice on the right bank to regulate supplies for irrigation. (The canal on this bank will not be excavated now.)

(6) Constructing a canal to irrigate 125,000 to 175,000 acres of lands, on the north bank of the river.

(7) Necessary plant for generating 5,000 H.P. of electric power will be installed at Sivasamudram.

(*b*) In the first stage, the foundations will be laid to full width required for the complete dam and the section of the dam completed up to 80 ft. on bed; above this level and up to 97 ft. on bed, a thinner section will be built according to sections given to allow of floods being disposed of on a temporary weir 1,800 ft. long, with a head of 12 ft. on crest at 80 ft. on bed. This weir will be built on the north bank of the river between chainages 42 and 60. The discharges will be trained off into a water course which joins the river, a little below the dam site. There will be constructed in this stage 6 under-sluices, each 6 ft. × 12 ft., with sills at 12 ft. above general bed level of river and two at a higher level each 4 ft. × 8 ft., with sills at 40 ft. above bed; one of these will be on the left bank and the other on the right bank.

(1) The temporary weir by itself will be capable of discharging 251,370 cft. per second with a 12 ft. head on crest. The six under-sluices will be capable of discharging 21,770 cft. per second and the two upper-sluices 2,457 cft. per second when the reservoir is full in the first stage.

(2) When the top work has to be taken in hand for the complete reservoir, this temporary weir will be removed and the dam with sluices, etc., as proposed for the complete scheme, will be built. In the first stage no irrigation sluices nor the higher level scouring sluices except the two mentioned above, will be constructed.

X. The length of the complete dam will be 6,300 ft. on top and top width 12·5 ft. The weir, 2,600 ft. long, will be located on the south bank with crest at R. L. 2454·00 or 110 ft. above bed of river. The maximum flood level will be 8 ft. above this or R. L. 2462·00 and a 6 ft. margin is allowed for waves, etc. The section adopted is the one prepared by the Chief Engineer and has been calculated so as to have the lines of pressures fall within the middle third, both when the reservoir is full and when it is empty. The maximum stress allowed is 8·30 tons per square foot with reservoir full; with reservoir empty 8·08 tons per square foot. The specific gravity of the masonry is taken as 2¼ and reasons for it will be found in Appendix G.* The other details will be found in the plans, estimates and statements of calculations accompanying.

Dam.

(1) The site has been carefully examined. The nature of the soil is explained in the accompanying report, Appendix H* and the State Geologist's report Appendix I. A number of trial pits have been excavated; and an examination of these shows that hornblende and gneiss are intermixed with micaceous quartz and soft gravel and with earth on the surface; the nature of the rock met with up to certain depths is not satisfactory and a good deal of decomposed and soft materials

has to be scooped out and removed. Provision is made in the estimate for excavation generally about 20 ft.; in places in the banks it is about 30 ft. deep. In the bed of the river there is rock throughout; but it is not of a compact nature and the proposal is to excavate 10 to 15 feet in it for securing good impervious foundations.

Waste weir.

(2) The waste weir, 2,600 ft. long, will be located on a spur on the south bank and the surplus over it will be discharged into two small drainages which join the river, about 3 furlongs below the dam site. It will be of sheer over-fall design; in places the rock met with, which also dips rapidly, is not of the hardest, and cushion walls and other protection are necessary. These places will be examined and necessary details for the protective works elaborated later on. The weir proposed will dispose of 182,000 cft. per second or 72 per cent of the maximum floods, with a head of under 8 ft. on crest of weir. The remaining portion of the floods will be disposed of by the under-sluices. The weir by itself will dispose of the maximum floods with a head of under 10 ft. on weir and the dam as designed is quite strong enough even should this increased head be reached.

Under-sluices.

(3) The twenty-six under-sluices proposed will be built with sills and dimensions as noted below:—

6 sluices each 6 ft. × 12ft. with sills at 12ft. above general bed level of river.
2 sluices one on each bank 4 ft. × 8 ft. with sills at 40 ft. on bed.
15 sluices each 6 ft. × 15ft. with sills at 50 ft. on bed on the right or south bank.
3 sluices on the left or north bank each 6 ft. × 15 ft. with sills at 50 ft. above bed.

When floods are at their maximum height, the total discharging capacity of the larger sluices, 18 in number, each 6 ft. × 15 ft., will be over 80,000 cft. per second. Stoney's patent or some other type of sluice gates will be adopted for working the sluices. Where the sluices are to be built, additional thickness will be provided for the dam; should any alterations be made in it, the cost can be met from the lump sums provided for protection to sluices and weir. The velocity generated by the discharge through the under-sluices being great, special protection to sides, vents and floor will be needed. This is also provided for.

Head sluices.

(4) A head sluice for irrigation will be constructed on the north bank of the river, at R.L. 2,404·00 or 60 ft. above bed of river.

(*a*) This level is adopted, as a line traced from it with requisite falls will completely command all the flat plains in the Mandya and Channapatna Taluks. Fixing a much higher level for the off-take will take the channel line unnecessarily into hills and rough country without corresponding advantages, and fixing a lower level will leave portions of good land above the channel line and further increase cost of tunnelling through the Hulikere saddle. From this latter point of view, *viz.* the cost of cutting through this range, a higher level than 60 ft. above bed for the off-take seems preferable. Such a decision would, however, leave a large quantity of water below the sluice level unused and there will also be difficulty in having to wait till water rises to that level for starting irrigation operations, as also at the tail end of the irrigation season when water in reservoir below sluice level cannot be drawn for irrigation. These points will be further examined when detailed surveys for the canal are in hand.

(*b*) The sluice consists of 3 vents, each 6½ ft. × 12 ft., and is capable of discharging about 3,000 cubic feet per second when water in the reservoir is 75 ft. above river bed Stoney's patent or some other type of shutters will be used for controlling the discharge. Below 75 ft. on bed, the water will be used for watering the hot weather crops and for power purposes.

(*c*) Another sluice for irrigation will be constructed on the right bank. The canal on this bank will command large extent of land in the Mysore and Nanjangud Taluks as also the Hulhalli anikat on the Kapila river. Should such a canal be opened, the present Hulhalli channel might be extended further into the T.-Narsipur Taluk, irrigating lands on the south bank of the Cauvery up to British limits.

Materials for construction.

XI. The dam, weir and sluices will be built all of stone masonry. The stone available here is mostly gneiss with a little hornblende to be quarried in the hills close to dam site. Lime stone is found here and there in the neighbourhood but not in

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sufficient quantities for our works. Good lime can be had in large quantities at Jettihundi, 4 miles from Mysore, and in the Mandya Taluk, at a distance of 13 to 25 miles from the dam site. There is some difficulty in procuring good sand. Small quantities are available near the Chikdevarayasagar anikat about 1½ miles below the site of dam. As it is proposed to use mostly surki mortar for the work, much sand is not required. Good brick earth is available close by. The main difficulty in the locality is the want of fuel for burning lime and bricks; small quantities are available from trees to be cut in the bed of the reservoir, but the major portion will have to come from the Kankanhalli jungle—partly by rail, partly by road. Cement will be used for particular portions in foundations and at the scouring sluices. Its use throughout will be very costly. Before work is put in hand, experiments will be carried out on the several materials to be used and the proportions in which they are to be used specified. Appendix L* enclosed treats of this question.

(*a*) For facility in carriage of materials, either a line of railway or tramway will be laid, the cost being debited to the sub-heads concerned in the estimate. The proposed railway line from Arsikere to Mysore will run not far from the work site and it will be considered whether it may not be possible to deviate a portion with advantage so as to bring the line nearer the works. Service roads will be opened for the works. The telephone line will be extended from Belagola Pumping works, the present terminus, to the site of the reservoir.

Rates, etc.

XII. The work is proposed to be carried out under Departmental agency as was done at Marikanave and by adopting task work agency, where necessary, to avoid rates having to be raised. Labour—total number about 20,000—has to be collected; the only local help that can be relied upon consists in the possibility to get some carts with a few coolies in the summer months, when the raiyats have finished their agricultural operations for the year. These go back to their fields directly rains fall. Wadders, masons and all other skilled and unskilled labour must be imported, masons from Northern India and wadders and coolies from the Ceded Districts and Madras. The resident population in the valley is hardly enough to attend to the usual agricultural work in the fields and gardens. Some advances will be found necessary in the commencement to collect labour.

(*a*) The valley of the Cauvery is notorious for its unhealthiness; proper quarters for the staff, sanitation, medical help, roads and facilities for getting supplies, have been provided for.

(*b*) It is proposed to proceed rapidly with the work and complete the first stage sufficiently to store water in 3 years after starting though it may take 4 years to fully complete this work. If the second stage is to be proceeded with as the first stage is completed, the period required for completing the whole dam work need not be more than 7 years. The estimates contain provision for the requisite establishment for this period.

SECTION 4.—CANAL.

Canal.

XIII. The line for the canal has been so traced that it commands three to four times the extent of land that is proposed to be actually irrigated. It is proposed to develop irrigation according to the block system with a view to prevent over-saturation of the soil and the country becoming unhealthy, as is now the case with irrigated tracts along the Cauvery in Mysore. Detailed surveys and sections have not yet been taken; rough sections have been taken and a general line for canal fixed; proper surveys will be undertaken when the general scheme is approved. A memo on the line, capabilities of irrigation, etc., is enclosed as Appendix J.

(*a*) The canal for irrigation will be, when fully completed, about 110 miles in length. The country to be traversed on the bank of the river and in the Lokapavani valley, miles 0 to 25, is very rough and the cutting for the canal will be costly. There is, further, a formidable obstacle in the Hulikere-Karighatta range of hills—miles 25 to 29 of the canal line—separating the Lokapavani and Shimsha drainages. The lowest point in the ridge is 140 ft. above the bed grade of the

* Not printed.

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canal in this section. It is proposed to cross the range through a tunnel to be bored close to the Hulikere village on the eastern side of the range. Several saddles were examined and the possibility of taking the canal in contour round the southern terminus of the range at Karighatta was also investigated. These have all been found to turn out very costly and given up. A copy of a memorandum on the subject of tunnelling through this range will be found as Appendix K among the enclosures.

(*b*) Beyond this range there are numerous valleys and some ridges to be crossed, but no special difficulty is likely to be met with. The larger streams—Bindenhalli stream, Shimsha, Amrattur stream, Nidasale Tore and Kanva—may be crossed either on aqueducts or by constructing reservoirs at them and taking off channels beyond. In places it will be found possible to tail off the canal into the streams and draw off supplies lower down at anikats either existing or to be constructed hereafter. There are several large cuttings also to be resorted to. The memorandum referred to above deals fully with these.

Irrigation proposed under the reservoir.

XIV. Under the main canal up to Channapatna, 110 miles in length, the lands commanded come to about 938 square miles or 600,538 acres. Of this extent, excluding the irrigation under the present river channels, 37,538 acres are either wet or garden cultivation and 241,347 are kharab, including jungle, unassessed waste, etc. A good portion of the 241,347 acres noted as kharab is also capable of being irrigated and, when irrigation is fully developed, the duty of water increased and more lands are needed for wet cultivation, some portions out of these unassessed lands may also be allotted for irrigation.

(*a*) The lands under the first portions of the canal where it runs in stony soil, up to French Rocks, are inferior. Also, the Chikdevarayasagar channel runs close to it. The canal from French Rocks to east side of the Hulikere range of hills runs in the steep Lokapavani valley. It is proposed, in the first instance, not to irrigate any lands until the Hulikere-Karighatta range is crossed, that is, in the first 29 miles. The lands to east of the Hulikere range are fairly good and the tract is populous. The lands beyond the Shimsha in the Kunigal, Huliyurdroog and Channapatna Taluks are superior and the country in the Channapatna Taluk especially is very flat.

(*b*) Should it be considered advisable not to raise the dam above the first stage, *viz.*, 80′ above bed of river, the supply in the reservoir may be used for extending irrigation under the existing river channels to the extent of 25,000 to 30,000 acres by extending certain channels at a cost of Rs. 16 lakhs. Appendix M* enclosed deals with the subject.

(*c*) There are numerous tanks in the tract between the Hulikere range and the Shimsha river and the cultivation of sugar cane and other perennial crops may be developed to a very large extent under them. These tanks may be filled during the monsoons with water from the Cauvery. When the reservoir is constructed to full height, an extent of 125,000 acres may be brought under irrigation. The canal may, if required, be extended beyond the Shimsha and up to Channapatna and a very large extent of land brought under irrigation. The details can be worked out when proper surveys and sections are undertaken for the canal. An agricultural survey of the tract will have to be taken and maps showing tracts to be irrigated prepared while the detailed surveys for the canal are in progress.

Storage how proposed to be used.

XV. The irrigation canal on the north bank of the river will not be excavated in the first stage. The supply in the reservoir will be used for ensuring supplies to the existing wet cultivation in the valley which can be increased by about 25,000 acres under existing channels by extending them. If the reservoir is not completed to the full stage early, it will afford complete protection to the hot weather crops which can to some extent be also extended, maintain the minimum supplies in the river in the hot weather months to work the turbines of the Power Station at Sivasamudram, without stoppage, and generate more power.

(1) Ensuring supplies to the present plant at Sivasamudram in summer for generating 10,000 H.P.	1,300	m. cft.
(2) Ensuring supplies to the new plant at Sivasamudram in summer for generating 5,000 H.P. extra for which there is an immediate demand	3,500	,,
and (3) Evaporation, ensuring hot weather crops and extending irrigation ...	6,230	,,
Total ...	11,030	

* Not printed.

(a) The storage in the second stage, *viz.*, 41,500 m. cft., is proposed to be utilised as noted below :—

(1) For power	...	10,000 m. cft.
(2) Evaporation	...	2,500 ,,
(3) Storage below irrigation sluices	...	4,400 ,,
and (4) Irrigation of 125,000 acres and supplies to hot weather crops and expanding latter to 45,000 or 50,000 acres	...	24,600 ,,
Total	...	41,500

N. B.—For power, 1,000 cft. per second will be set apart for the period of short supply in river. This is capable of developing 20,000 H.P. at Sivasamudram including the present power to the extent of 10,000 H.P. and the extra 5,000 H.P. for which there is an immediate demand. There will be demand for a considerable amount of power, should it be guaranteed there will be no interruption to supply of water in the hot weather months for working the turbines.

(b) There is also a proposal to construct a power station at the Shimsha Falls and work the turbines with water from the Cauvery. Should this be done, power to the extent of 30,000 H.P. can be generated with the quantity of water here provided, *viz.*, 1,000 cft. per second, at an extra outlay of about Rs. 30,00,000. A memorandum on the subject is attached.

SECTION 5.

XVI. The submersion of land in the bed of the reservoir is given in the accompanying tables. Table No. 1A* gives the area of submersion at 2,424·00, the weir level in the first stage; Table No. 2A gives the submersion at R. L. 2,436·00, the high flood level of the first stage; this is 24·15 square miles or 15,471 acres, of which 4,837 acres are wet, 484 acres, garden and 4,656 acres, dry land. The rest being either Government waste, village sites, nalas or river bed, do not require compensation. The loss of revenue due to this submersion is about Rs. 37,000 per annum. Proper contours at 80 ft. and 92 ft. above bed have not yet been taken. They will be taken when the proposals are approved.

Submersion.

(a) In the second or final stage, the extent of submersion at 2,462·00, the high flood level for that stage is 43·3 sq. miles or 27,703 acres; of this extent, 6,624 acres are wet, 650 garden and 11,208 acres dry. The rest are Government waste, village sites, nala and river beds. The number of villages to be submerged will be 17 and population displaced 9,470. The loss of revenue due to submersion in bed is Rs. 54,174 per annum. The tables give full details of the houses and temples as also the tenure of the lands coming under submersion.

(b) The compensation for the lands coming under bed is roughly provided for at an average rate of Rs. 80 per acre as given in the Revenue Commissioner's letter No. 15264—O. M., dated the 19th June 1907, to the address of the Chief Engineer of Mysore. In the estimate for the first stage, however, a rate of Rs. 160 per acre of wet and garden lands is provisionally entered as a smaller area has to be considered in this case and as the lands under the Kannambadi channel are reported to be more valuable than the lands under the other channels coming under submersion in this and the higher stage. For houses, all round rates of Rs. 80 for each tiled house and Rs. 20 for each thatched house are provided. The Kannambadi temple is a large one; it is considered sufficient to build in its place a smaller temple at a cost of about Rs. 3,000 higher up and, for the other temples coming under submersion, a rate of Rs. 200 each is provided. There will also be some portions of the Yelwal-Hassan road and Lingaraja Chattar-Kalhalli road coming under submersion and the Lakshmanathirtha bridge at Sagarkatte needs raising or reconstruction. Provision is made in the estimates for all these works. The tracing plan from Revenue Survey Village Maps enclosed shows all the villages and the lands referred to above. The rates and amounts allowed in the estimates must be considered only provisional, pending preparation of detailed compensation statements in the Revenue Department. Contour lines at different levels are marked on Revenue Survey Village Maps, and the areas at the several levels are given in detail.

* Not printed.

(c) It may be noted that the area between 80 ft. and 92 ft. above bed, the full tank level and high flood level of the first stage—about 4,000 acres in extent—will be available for agricultural purposes; but as they lie under water for a few weeks in the year, they are taken as excluded for cultivation purposes. By permitting these lands to be cultivated for certain crops during certain seasons, the amount provided for compensation will be reduced by about 2 lakhs of rupes. Similarly, in the final stage 4,648 acres between full tank level and high flood level may be made available for cultivation during certain seasons of the year reducing the compensation amount by about Rs. 3¾ lakhs.

(d) It may also be found advantageous to give such of the holders of lands coming under submersion as are willing to go to new places, fresh lands belonging to Government, either under the proposed north bank canal from the reservoir or under the proposed Mandigere channel extension. The latter has the advantage of being nearer to most of the villages coming under submersion. Suitable sites for villages may also be given them free and the owners of houses coming under submersion may further be allowed to take the materials—necessary deductions being made for their value in the compensation amounts to be fixed.

(e) The trees in the bed of the reservoir should be reserved to be utilised for burning lime and bricks, as far as possible, for the works as carriage charges from the jungles in the Hunsur and Kankanhalli Taluks for fuel and charcoal will be high.

Returns anticipated.

XVII. The cost of the reservoir up to the first stage is 81 lakhs of rupees and the approximate cost of procuring and fixing the requisite machinery for developing 5,000 H. P. at Sivasamudram is about 8½ lakhs; the cost thus totalling 89½ lakhs of rupees.

The returns on this capital expenditure will be :—

Increase from the present power of 10,000 H.P. at £2 extra per H.P.		£20,000 per annum.
Increase from the additional 5,000 H.P. at £12 per H.P	...	£60,000 per annum.
Total	...	£80,000 or Rs. 12 lakhs per annum.

Deducting depreciation and maintenance charges at Rs. 50,000 per annum, together with about Rs. 37,000, the loss of revenue by submersion in bed, and giving credit to the amount of Rs. 50,000 now spent annually on channels conservancy work, the return will be Rs. 12—·50—·37+·50=11·63 lakhs per annum, which is $\frac{11{\cdot}63\times100}{89{\cdot}5}$ or about Rs. 12·99 per cent of the capital expenditure.

The whole capital with interest at 4 per cent per annum, after meeting working charges, etc., will be recouped in 15 years and there will be from the 16th year a yearly net income of Rs. 8⅛ lakhs, as will be seen from the detailed working tables of expenditure and returns accompanying.

(a) If irrigation be included, the capital cost will amount to Rs. 89½+16 or 105½ lakhs.

The receipts will be :—

(1) From power, as detailed above	... ...	...	Rs. 12,00,000
(2) From irrigation 20,000 acres rice, at Rs. 6 per acre, net		...	„ 1,20,000
(3) From irrigation 5,000 acres sugar cane, etc., at Rs. 8, net		...	„ 40,000
Total		...	13,60,000

Deducting for maintenance charges of the power works at Rs. 50,000 per annum and working expenses on irrigation at eight annas per acre, as well as adjusting the loss of revenue by submersion in bed and savings from dispensing with channels conservancy work, the net receipts will be Rs. 13,10,500 per annum, which represents a return of 12·42 per cent.

(b) If a contribution of Rs. 10 per acre be levied on the 25,000 acres to be freshly irrigated, the return will be 12·72 per cent on the capital outlay.

(c) In the second stage the cost will be Rs. 254·00 lakhs and this will be reduced to Rs. 188 lakhs in the 12th year, when the higher rate of price for power ceases. From the 13th year the return will be—

		Lakhs Rs.
on 5,000 H.P. at £10 per H.P. £50,000 or	... ...	7·5
on 125,000 acres Rs. 6 (average) per acre	... ...	7·5
saving due to discontinuing channels conservancy work	...	0·5
Total gross return	...	15·5

			Lakhs
Deduct—(1)	for depreciation and working charges (Power)	...	0·50
(2)	for irrigation at 12 annas per acre	...	0·94
and (3)	for loss of revenue in bed	...	0·54
			Rs. 1·98

The net revenue will be Rs. 13·52 lakhs per annum.

This represents $\frac{13·52 \times 100}{188}$ or 7·19 per acre. If we take the contribution of Rs. 10 per acre, the percentage of return will be 7·70 per cent.

From the detailed working table of expenditure and returns accompanying it will be seen that the capital with interest at 4 per cent per annum, will be recouped in the 32nd year after starting work, meeting all working charges, etc. There will thenceforth be a yearly income of Rs. 13·88 lakhs after meeting all working charges.

(*d*) In the above, no demand for further power is taken into consideration. By opening a supply channel from the Sivasamudram anikat to the Shimsha river bank to work turbines to be installed at the Falls there, a large amount of power can be economically developed. The cost of the supply channel is roughly estimated at Rs. 14,00,000 and the Electrical portion of the scheme may cost another 16 lakhs—the total coming to Rs. 30,00,000. About 10,000 H.P. of electricity may be generated there; with this power and the 5,000 H.P. additional, generated at Sivasamudram and the irrigation under the reservoir, we may anticipate a return of Rs. 24,00,000 per annum on the capital expenditure. The net return, taking the whole project into consideration, will be $\frac{(13·52+14·50)\ 100}{188+30}$ or about 13 per cent. A separate preliminary project for this portion of the scheme is submitted with this office letter No. 59, dated the 16th February 1911.

(*e*) The protection given to present hot weather crops and to present power is not taken into consideration, nor the increase in royalty amount that may be expected from additional output of gold due to cheap power being available.

Present irrigation in the valley.

XVIII. The Cauvery and its tributaries have been largely drawn upon for irrigation purposes both in the Mysore State and in the Madras Districts along the Cauvery. That this has been so from immemorial ages is seen from the fact that the Scanda and Augneya Puranas state that in the discussion regarding the merits of the Cauvery and the Ganges it was stated that the former gave men food and drink, while the latter could give drink only. The recent irrigation works in the United Provinces have considerably altered this state of affairs.

(*a*) The extent of irrigation in the Mysore Province under the more important channels drawn from the Cauvery and its tributaries, is seen from the statement enclosed as Appendix N. The revenue realised from this irrigation annually, is about 7 lakhs of rupees. When irrigation is fully developed as detailed above, the revenue from river irrigation will reach 14½ lakhs per annum. The extent of the Cauvery irrigation in the Madras Districts is also very considerable and the Madras Public Works Department Irrigation Branch Administration report for 1908-09, gives this as a little over one million acres, with about 100,000 acres of the atchkat raising a second crop, the total yield annually being Rs. 48¾ lakhs to Government.

Effect on the river supplies lower down.

XIX. The enclosed statement of supplies to be stored in the reservoir and what will be directly drawn from the river for irrigation, shows that we want 40,500 m. cft. per annum. Out of this should be deducted the 3,000 m. cft. per annum which are now being used for irrigating the 7,274 acres of wet and garden lands and which will be set free by these lands coming under submersion when the reservoir is constructed. The portion of river supplies proposed to be intercepted will thus be 37,500 m. cft. and this quantity will be drawn from the river in the south west monsoon months—June to August—when the river carries down much larger supplies than are needed for irrigation in Mysore and Madras. From September onwards water is not proposed to be drawn from the river except to the extent which is being used now for irrigation under the existing channels. It may be noted that, from December to the middle of May in an average year, the

discharge in river will be more after the construction of the reservoir than is now the case due to supplies from the reservoir drawn to work the turbines at Sivasamudram returning into the river.

(a) The quantity proposed to be now drawn from the river for use in Mysore, *viz.*, 37,500 m. cft. per annum (this corresponds very nearly to storage in reservoir above irrigation sluice level) is between $\frac{1}{6}$th and $\frac{1}{7}$th of the average supply discharging in river at the site of the reservoir. Taking the average annual discharge at Sivasamudram between $\frac{1}{10}$th and $\frac{1}{11}$th of the discharge is proposed to be stored in Mysore. In the worst years like those of 1901 and 1905 our proposals would involve an abstraction in the river supplies of between $\frac{1}{7}$th and $\frac{1}{8}$th of the discharges at Sivasamudram.

(b) Besides this flow in the Cauvery at Sivasamudram, there are the Shimsha and Arkavati streams draining 3,235 and 1,556 square miles, respectively, within the Mysore Province and carrying the surplus floods on to Madras. The actual discharges in these two streams have not been gauged. Taking the average rainfall of the tract at 27·5 inches per annum and the percentage of run-off for this catchment at 12·00, the average annual discharges in these two streams may be roughly estimated at 37,000 m. cft. The total average volume of water passing through the Mysore State to Madras in the Cauvery, is thus about 431,000 m. cft. per annum. The quantity proposed to be intercepted according to this project is 37,000 m. cft. per annum, which is between $\frac{1}{11}$th and $\frac{1}{12}$th of this discharge.

(c) Out of the quantities of water drawn off in our channels for irrigation, very large quantities return quickly—owing to the steep slopes of the country and the nature of the soil—to the river. This will reduce quantity used in Mysore by the construction of the proposed reservoir to between $\frac{1}{15}$th and $\frac{1}{20}$th of the total run-off through the State.

(d) The bulk of the Cauvery irrigation in Madras is in the delta where the floods are considerably increased by additional supplies from the Bhavani, Amaravati and the Noyel streams. The construction of the reservoir will have the effect of moderating the intensity of the floods during the south-west monsoon, thus increasing their duration and enabling the raiyats to use more of the flood water for their fields and of increasing the flow in the river in the dry months of the year.

Summing up.

XX. To sum up, it is proposed to construct a reservoir at Kannambadi across the cauvery river to store 41,500 mil. cubic ft. of water, with the object of (1) maintaining the requisite minimum flow in the river in the short supply season to enable the turbines of the existing Power plant at Sivasamudram working without stoppage and to increase generation of power, (2) assuring sufficient supplies to the existing wet and hot weather crops (which will also be expanded) under the existing river channels and (3) extending irrigation into the tract to north of the Cauvery which is subject to drought. The extent of this additional irrigation will be about 125,000 acres.

(*a*) The above works are proposed to be carried out in two stages :—

No. 1 stage.—Building the dam at a cost of Rs. 81 lakhs so as to store 11,030 million cubic feet of water. This will protect present power and enable 5,000 H.P. additional, for which there is an immediate demand, being generated. The present hot weather crops will be fully protected and some additional sugar cane and other valuable crops will also be cultivated. Some additional irrigation to the extent of 25,000 acres may also be secured at an outlay of Rs. 16 lakhs, if it is decided not to raise the dam any higher. The canal will not be excavated in this stage.

No. 2 stage.—The scheme will be fully developed in this stage. The reservoir will be enlarged to store 41,500 mil. cubic ft. and it will irrigate fresh lands in the dry tract to north of the river to the extent of 125,000 acres. The extent of valuable perennial crops will expand to 35,000 or 40,000 acres. Additional power will also be generated either at Sivasamudram or at the Shimsha Falls when there is demand for it by cutting a supply channel from Sivasamudram anikat at a cost of about 30 lakhs—14 lakhs for the channel and 16 lakhs for the Plant.

(*b*) The project is one capable of further development and the tract in the plateau subject to complaints of drought can be protected over an area of about 2,000 square miles.

XXI. A proper programme for proceeding with the work together with specifications, as also rules for working the reservoir when constructed and for the irrigation under it, will be got up when the scheme is generally approved.

XXII. The project for the dam was, under my instructions, got up by Mr. K. R. Seshachar, Assistant Engineer, and the preliminary project for the north bank canal, by Mr. M. A. Ananthalwar, Assistant Engineer.

CAUVERY RESERVOIR PROJECT.

ESTIMATE OF COST.

Dam of thinner section—Storage 80 feet.

Quantity	Description of work	Rate	Amount
1	2	3	4
	PRELIMINARY.	Rs. a. p.	Rs.
	Preliminary expenses	.....	1,00,000
	LAND.		
	Land compensation.		
5,256	Wet land	160 0 0 Acre ...	8,40,960
4,408	Dry land	25 0 0 Do ...	1,10,200
721	Tiled houses	80 0 0 Each ...	57,680
233	Thatched houses	20 0 0 Do ...	4,660
2	Constructing Kannambadi temples ...	1,500 0 0 Do ...	3,000
11	Compensation for the temples	200 0 0 Do ...	2,200
2,300	Constructing a new bridge across the Lakshmanathirtha river.	20 0 0 Square foot of waterway.	46,000
8	Diversion of roads	1,500 0 0 Mile ...	12,000
			10,76,700
	WORKS.		
	Construction of main dam.		
	Clearing and unwatering foundations ...	.....	1,89,222
95,505	Excavation in hard rock	1 8 0 C. yd. ...	1,43,258
94,095	Do in moderately soft rock ...	0 12 0 do ...	70,571
47,418	Do in very soft rock and gravel ...	0 4 0 do ...	11,855
3,207	Washing foundations, etc.	6 0 0 Sqr. ...	19,242
	Choking springs	Lump sum ...	5,000
113,156	Cement concrete	0 14 6 C. ft ...	1,02,547
104,50,057	Rubble masonry	24 0 0 100 C. ft.	25,08,014
3,470	Cement pointing	6 0 0 Sqr. ...	20,820
52,500	Flooring on top of dam	0 3 0 Sqr. ft.	9,844
	Parapet wall or railings, etc.	Lump sum ...	20,000
40,000	Filling foundation trenches, etc.	0 4 0 C. yd. ...	10,000
			31,10,373
	Sluices.		
8	Scouring sluices, 6 vents of 6′ × 12′ each in river bed and two vents of 4′ × 8′ each on the right and left banks.	.....	3,46,680
	Waste weir	.....	6,50,000
			41,07,053

Cauvery Reservoir Project.

Quantity	Description of work	Rate	Amount
1	2	3	4
	BUILDINGS.		
	Office.		
1	Public offices	.....	6,000
1	Police lines	.....	2,000
1	Post office	.....	1,500
1	School	.....	1,500
	Work buildings.		
	Stores, Workshop, Cement sheds, Machine sheds, Testing sheds, Magazines, etc.	.....	18,000
	Quarters for staff.		
20	Officers and Upper Subordinates	.....	26,900
70	Clerks, Draftsmen and Sub-Overseers ...	.....	33,100
150	Peons, servants, fitters and drivers ...	.....	3,900
40	Temporary maistries	.....	1,200
			65,100
1	First Class Inspection Lodge	.....	9,000
1	Hospital with in-patient ward	.....	6,900
	Repairs during construction	.....	10,000
			1,20,000
	MISCELLANEOUS.		
	Opening out road	Lump sum ...	5,000
	Arranging places for bazaars and *Santhes* ...	Do ...	2,000
			7,000
	Water-supply.		
	Fitting up pumps	Lump sum ...	5,000
	Storage reservoir	Do ...	5,000
	Filter	Do ...	4,000
	Distribution pipes	Do ...	8,000
48	Maintenance	100 0 0 month...	4,800
			26,800
	Temporary bridges, boats, etc., during construction.	Lump sum ...	10,000
	Protective work for temporary weir during construction.	Do ...	20,000
	Repairs during construction for dam works ...	Do ...	10,000
48	Medicine and Sanitation	700 0 0 month...	33,600
	Unforeseen charges	Lump sum ...	75,000
			1,82,400
			55,86,153
	Contingencies at 5 per cent	.....	2,79,308
	Total ...	.....	58,65,461
	ESTABLISHMENT CHARGES	.....	5,79,233
	TOOLS AND PLANT	.....	2,00,000
	Grand Total ...	.....	66,44,694 or 66·5 lakhs.

i.—Statement showing Financial results.

First stage including Irrigation.

	Rs.	Rs.
Capital Outlay—		
Dam	81,00,000	
Fourth electrical installation at Sivasamudram	8,00,000	
Extending existing channels for irrigating 25,000 acres additional land.	16'00,000	
Total ...	...	1,05,00,000
FINANCIAL RESULTS.		
Receipts—		
(*a*) Increase in income from present power supply of 10,000 H.P. at £2 extra per H.P.	3,00,000	
(*b*) Income from additional supply of 5,000 H.P. at £12 per H.P.	9,00,000	
(*c*) Savings in channels conservancy works after the reservoir is constructed.	50,000	
(*d*) Extra revenue from 25,000 acres—20,000 acres rice at Rs. 6 per acre and 5,000 sugar cane at Rs. 8 per acre.	1,60,000	
	14,10,000	
Deduct—		
(1) Depreciation and working charges (power)	50,000	
(2) Working charges on irrigation at annas 8 per acre ...	12,500	
(3) Loss of revenue due to submersion in bed of reservoir ...	37,000	
	99,500	
Net Receipts ...		13,10,500
The return will be Rs. 13'105 lakhs on 105'00 lakhs or 12'5 per cent.		

ii.—Statement showing probable distribution of supplies.

Complete Scheme.

Available storage—37,080 million cubic feet.

Months	Dependable flow in river		Supply required for—	
	Cubic feet per second	Monthly supply in million cubic feet	Power in million cubic feet	Irrigation in million cubic feet
September	.....	.....	.....	4,406
October	.....	.....	.....	4,406
November	.....	.....	.....	4,406
December	.....	.....	.....	4,406
January	600	1,555	2,592	2,851
February	500	1,296	2,592	1,296
March	500	1,296	2,592	1,296
April	400	1,036	2,592	1,296
May	700	1,814	2,592	1,296
June, first half	700	907	1,296	648
June, second half	1,000 or more	.....	.....	.....
		7,904 (A)	14,256 (B)	26,307 (C)

NOTE :—1. It is proposed to irrigate about 150,000 acres of which 30,000 will be under perennial crops.
2. Discharge required for power supply—1,000 cusecs.
3. Usual period of storing—From 16th June to 31st August. The natural flow of river will be used only during this period for irrigation.
4. Total storage utilised after 1st September, B+C—A=32,654 million cubic feet.

iii.—Statement showing probable monthly distribution of supplies.

First stage or Partial Scheme.

Storage 11,030 million cubic feet.

Months	Dependable flow in the river		Supply required for—	
	Cubic feet per second	Monthly flow in million cubic feet	Power in million cubic feet	Irrigation in million cubic feet
September	.....	.....	.....	994
October	.....	.....	.....	994
November	.....	.....	.....	994
December	.....	.....	.....	994
January	600	1,555	1,944	605
February	500	1,296	1,944	215
March	500	1,296	1,944	215
April	400	1,036	1,944	215
May	700	1,814	1,944	215
June, first half	700	907	972	107
June, second half	1,000 or more	.....	.....	.....
		7,904 (A)	10,692 (B)	5,548 (C)

NOTE:—1. It is proposed to irrigate 25,000 acres of which 5,000 acres will be under perennial crops.

2. Discharge required for power supply—750 cusecs.

3. Usual period of storing—From 16th June to 31st August. The natural flow of river will be used for irrigation only during this period.

4. Total storage utilised after 1st September, B+C—A=8,336 million cubic feet.

ELECTRIC POWER SUPPLY SECTION.

Letter No. 386, dated the 31st January 1911, from H. P. Gibbs, Esq., M.A.I.E., M.I.E.E., *Chief Electrical Engineer to the Government of Mysore, to the Secretary to the Government of Mysore, Public Works Department.*

FOURTH INSTALLATION.

I have the honor to forward herewith a report on the method of carrying out the work of the proposed Cauvery Fourth Installation together with a lump-sum estimate. You will notice that the amount of practically 8 lakhs is arrived at by including credit for timber and copper. In this connection, I would like to explain that there will be considerably more actual credit on account of line insulators, of transformer copper, and lead and copper from the existing generator cables now in use between the Power House and Step-up Transformer Station. I have not taken these into consideration in making up the estimate, as the quantities cannot be quite so readily estimated and the insulators are not so directly negotiable an asset. You may, however, assume that this will be from ½ to ¾ of a lakh more. I, however, wish to suggest that you hold this in hand as a contingent on the whole work. As you already know, our plans are nearly completed, so that we are in a position to call for tenders as soon as it is decided to carry out the work. On receipt of quotations from the various firms to whom we shall apply, a revised estimate may be submitted with somewhat more in detail if then desired.

Report on Proposed Cauvery Fourth Installation explaining Method of Extension.

Forebay.—A connection, with three penstock outlets, will be made to the Transformer House side of the existing forebays, the wall of which will face across the end of the Step-up Station. These outlets will be made low enough at pipe outlets to allow for burying the penstocks in a manner to avoid blocking transportation facilities in front of the Step-up Station.

Penstocks.—Two penstock lines will, at present, be installed, carried across in front of the Transformer House and turned alongside of the building running to the Generating Station on the up-river side of the Cable Duct.

Generating Station.—This building will be extended up-stream approximately 60 feet, providing space for 3 units of 2,000 Electric Horse Power capacity each, two of which will be installed.

All generator switches will be equipped for remote control. The generator field rheostats will be left above in the Step-up Station and arranged for remote control also.

Cable way.—The low-tension bus-bars will be placed in masonry compartments built against the outer wall of the lean to, and will be extended in flat copper mounted on insulators up the existing Cable Duct. This is intended to displace the present lead-covered three-core generator cables, which, as the plant capacity increases, become a decided source of danger.

STEP-UP STATION.

Transformers and High-Tension Work.—Of the existing air blast transformers, 15 would permanently be removed and replaced by 12 oil insulated ones of 1,250 K. W. capacity each to operate at 70,000 volts.

The existing front air duct wall will be built up to present gallery level and extended to the end wall of the building. The gallery will then be reconstructed

using heavier girders resting on this raised wall thereby increasing the gallery breadth.

All transformers will be placed below the gallery on ground floor and suitably arranged in compartments.

The gallery will carry the High-Tension Transformer Switches and High Tension Bus-bar Compartments.

Low-tension work.—The extended Low-Tension Bus-bars from the power house will be extended along the wall of basement for convenient metering and connecting to the low-tension side of the transformers.

Switchboards.—The existing generator and transformer switch boards will be done away with and this work be brought on to a Remote Control Switchboard.

Local work.—It is not intended at present to complicate the remote control by bringing the local power and lighting circuits on it.

New Remote Control Board.—This will be centrally located on present floor level and will control generator switches rheostats, exciters low-tension transformer switches, beside high-tension transformer and line switches.

Line Outlets.—A new Line Tower for the two 70,000 volt Kolar lines will be built between the existing Kolar and Bangalore lines towers. This will contain the 70,000 volt line switches, lightning arresters and current transformers. It will also serve as a transformer assembly room. These lightning arresters should be of the modern electrolytic type.

Transmission lines.—The existing Mysore lines will be left in the present tower. The Bangalore lines will be placed in the tower now used for the two $^1/_0$ Kolar lines.

The two $^1/_0$ Kolar lines will be brought into the new tower. These two Kolar lines will be reconstructed increasing the normal spans to $2\frac{1}{2}$ times the present spacing, making them 330 feet.

New steel poles of the type used on the No. 1 Kolar line will be purchased sufficient for purposes of reconstruction, utilising the poles now in No. 1 line.

The poles used in reconstruction for permanent work will be made up by letting the No. 1 line standard pole into the No. 2 and 3 lines wrought iron sockets, which will make a pole standing 34 feet above ground.

New insulators will be purchased and the two will be of modern suspended type construction.

The copper from No. 1 line and timber tops of 2 and 3 lines may be disposed of and credited to the new work.

Section Houses.—The line entrances will be reconstructed for increased spacing of wires and the present switch arrangements removed. Simple disconnecting switches will then be installed for the purpose of cutting out line sections.

Step-Down Transformer House.—The work here will be similar to that in the Step-up Station save that line entrances will be near north end of building and remote control will only be applied to line switches and high-tension and low-tension transformer switches. The existing feeder panels will be kept intact except that capacities, where necessary, will be increased and the low tension busses will be placed in a manner similar to those now in use at Sivasamudram.

All air blast transformers will be removed so that the reconstructed high-tension gallery may later be carried the entire length of the building if desired.

PRELIMINARY LUMP SUM ESTIMATE.

Cauvery Power Fourth Installation.

Power House—

	Rs.
Building extension	50,000
Two 2,700 H.P. turbines	50,000
Two 1,500 K. W. generators	62,000
Two switch cell equipments	1,800
New switches, existing machines	9,000
Importation and erection, turbines	14,000
Do generators, etc.	15,000
	2,01,800

PRELIMINARY LUMP SUM ESTIMATE—*concld.*

Forebay and Pipe Lines—

	Rs.
Two penstocks, complete	52,000
New forebay	15,000
Forebay outlets with valves	8,000
Importation and erection penstocks	8,000
Penstock foundation and excavating	3,000
	86,000

Step-up Station—

12 transformers	1,10,000
Building work	30,000
New H. T. bus and switches	50,000
New L. T. switches	5,000
New line switches	5,000
New lightning arresters	7,500
Bench control board	6,000
Remote control conductors	10,000
Miscellaneous material	7,500
New busses with extensions	40,000
Contingencies	11,800
	2,82,800

Transmission Lines—

900 poles, new at Rs. 45	40,500
10,000 suspension insulators	1,00,000
6,000 cross arms	20,000
Section house work, complete	10,000
Pole setting	11,000
Carting, etc.	8,000
Placing insulators and wires	10,000
Removal and storing of old material	16,000
400 poles from stock	18,000
Contingencies	11,700
	2,45,200

Step-Down Station—

Building work	20,000
Transformers	1,10,000
H. T. switches and bus	50,000
New line switches	7,500
New lightning arresters	7,500
New L. T. switches	5,000
New instruments	5,000
Miscellaneous equipment	7,500
Importation and erection	35,000
Contingencies	11,500
	2,59,000

Estimated Credit—

From old pole tops 30,000 cft. of timber at Rs. 1-8-0	45,000
310 tons of copper	2,30,000
	2,75,000

The total debit in above estimate	10,74,800
The credit on timber and copper	2,75,000
Total net cost	7,99,800

Letter No. 1171, dated the 3rd April 1911, from H. P. Gibbs, Esq., M.A.I.E.E., M.I.E.E., *Chief Electrical Engineer to the Government of Mysore, to the Secretary to the Government of Mysore, Public Works Department.*

CAUVERY FOURTH INSTALLATION.

With reference to your urgent 119—C. P. S., dated the 1st of April 1911, and your personal note thereon of the 3rd instant, I have the honor to submit the following:—

(1) As we have recently renewed the runners and nozzles of the six turbines of the First Installation, we have an increased capacity of 1,000 H.P. so that the Generating Station capacity may now be considered as 14,000 Electrical horse power instead of 13,000, of which 2,000 Electrical horse power may at present be considered as reserve capacity, leaving available for transmission 12,000 H.P. which is our present maximum demand. Our average demand is about 600 Electrical horse power less than this.

(2) With all plant in good normal operating condition, 485 cubic feet per second of water are required to produce 13,000 Electrical horse power.

(3) The Installation of 4,000 H.P. in the Generating Station will enable us to supply to our customers about 3,330 Electrical horse power. The transmission line losses on the Bangalore and Mysore Services are about 5 per cent, while that of the Kolar Service is at present approximately 16 per cent.

(4) For the supply to consumers of 3,330 H.P. more, we shall require approximately 150 cubic ft. per second more than we are now using, so that our total requirement would then become about 600 cubic ft. per second.

(5) The existing channels will readily carry the water required without increasing the height of the banks. It will only be necessary to raise the masonry walls a few inches at the overflow vents.

2. If the Fourth Installation work is not carried out, it will be necessary to reconstruct about one-third of the two Kolar transmission lines of the First Installation renewing the timber section of the poles, which, it is estimated, would cost approximately Rs. 40,000.

3. It is my understanding that, to facilitate irrigation on a large scale, it will be necessary to construct a reservoir, holding a supply of water for power considerably in excess of any probable requirements of the near future. If this is the case, it would not seem to me advisable to undertake the building of a new plant on the Shimsha for several years. The life of the Gold Mines is always problematical and I should not advise Government to undertake to supply more than 5,000 H.P. above their present demand unless some special arrangement be made whereby the speedy return of Government's capital would be absolutely sure. We are now making provision in our plans for the installation of a third generator of 2,000 H.P. capacity, which will enable you to supply 5,000 H.P. more than you are now doing. Personally, I very much doubt your being called upon by the Mining Companies to supply more at any time than this amount.

4. When the Mining Companies' demand commences to reduce, as it must one day do, their relinquishment of power will be a gradual one. It is quite probable that demands of other local industries will be arising sufficient to gradually absorb the power which thus becomes available. Finally, I may say I believe the undertaking very sound for Government up to the installation of 20,000 H.P. now being provided for in the Generating Station, of which 17,000 to 18,000 will be available for supply to the Transmission Lines, the balance being held in reserve, but I do not think they would at present be well advised to go further. You will understand that the three additional generators will give you this capacity as far as the Generating Station is concerned. Our proposals provide for the installation of the extra transformer capacity, and increasing the voltage of the system will reduce our present losses on the Kolar transmission line by practically 50 per cent, making a gain in capacity at Kolar of about 900 H.P.

Letter No. 3088, dated 23rd June 1912, from C. F. Beames, Esq., M.A.I.E.E., *Chief Electrical Engineer to the Government of Mysore, to M. Visvesvaraya, Esq.,* M.I.C.E., C.I.E., *Secretary to the Government of Mysore, Public Works Department, Bangalore.*

FOURTH INSTALLATION.

I now have the honour to submit a more detailed report and estimate to cover the proposed extensions and changes in the Sivasamudram and Kolar Sections and their interconnecting circuits, to meet the additional power requirements of the Mining Companies.

GENERAL.

The present scheme follows closely along the lines indicated in this office letter No. 386, dated the 31st January 1911, and submitted by my predecessor, Mr. H. P. Gibbs. In studying the details closely, some modifications to the original plan have been considered advisable, but are unimportant when taken on the whole. The principal modification has been in the size of transformers to be employed, and it is now proposed to utilise transformers of 1,750 K. W. capacity each, instead of those of 1,250 K. W. each. The advantages to be obtained by this change are the saving in flood-space in our Sivasamudram and Kolar Transformer Stations, in both of which the areas are limited, also a slight saving in the cost per K. W. of capacity due to the larger size of transformer being slightly cheaper per unit than the smaller.

Notwithstanding the seeming delay in the submission of the present estimate, it has not been possible to secure firm tenders for the minor switch gear and apparatus owing to the very considerable amount of detail work which was required in the preparation of specifications for this new material, after planning the utilization of as much as possible of the existing switch gear and instruments in the new arrangements of Transformer Stations. The detailed tenders are weekly expected, but owing to their non-receipt, those details of the estimate must be considered in the light of calculated figures and not firm ones.

PLANS.

Complete general plans have been prepared and blue print copies are herewith submitted. The detail dimensions in connection with the several of these are approximate and subject to change after receipt of working drawing from the manufacturers.

REPORT.

SIVASAMUDRAM SECTION.

Forebay.

The original proposal providing a connection with three penstock outlets, will be made on the Transformer House side of the existing forebays with the slight modification that the forebay extension will be laid out at an angle of 45 degrees to the upper forebay instead of 90 degrees as proposed in the original design. This change will not increase the cost of the work but will eliminate one angle in each of the new penstocks. The outlets will be placed low enough to avoid blocking transportation facilities in front of the Step-up Station.

PENSTOCKS.

Two penstock lines will be provided for, and with the exception of the necessary angles near the up-stream and of the Step-up Station, the penstocks will be laid on tangents between the forebay and the Generating Station. The proposed forebay and penstock locations will be shewn on drawings and submitted as soon as the new surveys now under way are completed.

GENERATING STATION.

The present building will be extended for approximately 60 feet at the up-stream end, which will provide space for 3 generating units of 2,000 Electrical Horse Power capacity each, only two of which will be installed at present. Please refer to the following drawings :—.

1221. Plan of proposed extension to Generating Station.

S. 417. Shewing end and side elevations of proposed extension to Generating Station.

S. 412. Bus-bar arrangement in Generating Station (one-half.)

S. 413. Bus bar arrangement in the remaining half of the Generating Station.

S. 414. Bus-bar arrangement, Generating Station (behind panels).

S. 416. Diagram shewing the system of electrical connections for Generating and Transformer Stations.

We propose to operate all generator and exciter switches from the Step-up Station by means of the " Remote system of control," also the Generator and Exciter Field Rheostats, provided the cost for this equipment (which is awaited) is not found excessive.

CABLE WAY.

The present three-core lead covered cables connecting the generators, with the switchboards in the Step-up Transformer Station have become overloaded due to the heavy load on the station, and are a decided source of danger to the system. It is proposed to replace these with one set of 3 bus-bars to be made up of flat copper strips supported upon special insulators across the existing cable way, and provided with necessary anchors and expansion joints to prevent travel of the bus-bars due to expansion and contraction.

The operation of Generating Station switches and rheostats also connections between the instruments and transformers located in the Generating Station and the instruments located in the Transformer Station will be made through low-tension cables supported on the existing ledges in the masonry cable way. Please refer to the following drawings :—

S. 411. Bus-bar arrangement in the cable duct.

1053A. Profile of grade between Power Station and Step-up Transformer Station.

STEP-UP TRANSFORMER STATION.

The present Transformer Station is equipped with transformers of the air-blast type which supply 35,000 volts to the three Kolar circuits and to the two Bangalore circuits. For the Mysore service, transformers of the oil cooled type are employed for supplying current at 25,000 volts. NOTE.—(It is proposed to change the Mysore voltage to 35,000 volts at a later date.) The intention is to raise the voltage for transmission to Kolar from 35,000 volts to 70,000 volts in order to reduce the present excessive losses in transmission, and as the air-blast type of transformer cannot be made to operate at this extra high voltage, it is planned to remove all but nine of these and to re-arrange the building to admit the installation of 9 new transformers, each of 1,750 K. W. capacity of the oil insulated and water cooled type, for regular service at 70,000 volts, also one similar transformer to be held in reserve in case of emergency. The transformers will be arranged with taps from their windings to allow of these close voltage adjustment. The 9 transformers will give us capacity for 15,750 K. W. equal to 21,105 H.P. under normal operating conditions, or with 25 per cent continuous overload on each of the transformers, the aggregate capacities will equal 19,687 Killo-watts or 26,381 H.P.

Assuming an accident to one set of 3 transformers, the capacity of the remaining 6 transformers would equal 10,500 K. W. or 14,070 H.P. under normal rating, or when operated continuously at 25 per cent overload, the capacity available would be 13,125 K. W. or 17,587 H.P. more than ample to take care of the proposed additional supply required by the Mines for the next 2 or 3 years, even in the event of one bank of transformers being out of service.

In plan S. 402, the general arrangement and location of the new transformers in relation to those of the present type which will still remain, is shewn, also the

proposed extension at the side of the building to accommodate the new bench-board (switchboard) for the control of Generating and Step-up Transformer Stations. The plan also shews the proposed locations for the high tension, transformer and line-switches.

Plan S. 401 shews vertical section taken through the centre of the building and indicates the proposed switchboard gallery, 2,300 volt bus-bars, 2,300 volt transformer oil switches, 1,750 K. W. transformers, locations for oil and water circulating pipes, passage way for the removal of transformers by means of a small tram line, and in the left extension of the building, the arrangement of oil switches, disconnecting switches and switch gallery.

Plan S. 403 shews vertical section of the present building and the proposed arrangement of those "air-blast type" transformers which will remain, for 35,000 volts service and the control apparatus for this service.

Plan S. 404 shews the longitudinal section of the Transformer Station as seen from the site of the proposed new switch board room.

Plan S. 405 gives details of the proposed arrangement of high tension leads.

Plan S. 406. Details of the proposed high-tension delta connections and pipe arrangement.

Plan S. 407. Details of the proposed low-tension delta connections and transformer oil valve control.

Plan S. 408. Proposed arrangement of high-tension leads.

Plan S. 409. Proposed arrangement of transformer bank and pipe supports.

Plan S. 410. General lay-out of the proposed bench-board and instruments.

NOTE :—The majority of instruments shewn will be supplied from our present station.

Plan S. 415 shews the west view of Step-up Transformer Station and extensions to same indicated in dotted lines. The new entrance for transformers at this end of the building is omitted.

Plan S. 419 shews details of the proposed supports for high-tension bus-bars.

Plan S. 420 shews proposed extension to the Transformer Station at the down-hill side to provide workshop space with sufficient head-room for the removal of transformer cores from their cases, the repairs to transformers, the testing of transformers and the drying of oil used within them. A suitable head-operated crane is proposed for installation within the workshop building to permit of the prompt and safe handling of the heavy transformer parts, etc.

As a regular supply of water will be required through the cooling coils of the new transformers, it is proposed to instal a motor-driven Centrifugal Pump to draw water from the forebay and return the same to the forebay (at a distance from the intake) after use. This pump will be properly housed.

Outside the main building will be located 2 sets of aluminium lightning arresters for the protection of the 2 remaining Kolar transmission circuits.

TEMPORARY TRANSFORMER STATION.

In view of the extensive and somewhat complicated alterations required to the present transformer station building and to the high and low tension wiring within the same, it is considered unsafe to attempt the alterations by piece-meal, owing to the continual liability of unskilled labourers coming in contact with some of the many high-tension conductors now existing. To reduce as far as possible danger to life during the re-construction period, and to facilitate the changes, it is proposed to erect a temporary building constructed of old posts and rails covered with corrugated galvanized iron, for the housing of the 35,000 volts Step-up Transformers now required for Kolar service. This building would be located on land lying between the present Transformer Station and machine shop in close proximity to our transmission wires. The present transformers would be shifted to the temporary building in sets of 3 and immediately placed in service. Upon the removal of all Kolar transformers, the high-tension transmission lines would then be cut off from the permanent Transformer Station, leaving only the Bangalore and Mysore Transformers and their equipment at the extreme ends of the building, and the 2,300 volt bus-bars and switch gear for the Kolar transformers with temporary 2,300 volt connections between the two buildings. This arrangement will not only permit of the safer and more satisfactory installation of the new apparatus, but will

also provide storage space for the air blast transformers and the switch-gear, etc., which will be permanently removed from regular service upon the completion of the installation of the new apparatus.

TRANSMISSION CIRCUITS.

There exist 3 transmission circuits between Sivasamudram and our Champion Reef Transformer Station at Kolar Gold Fields. Two of these employ No. O. B. & S. gauge line copper supported by 35,000 volt pin type insulators on wooden cross arms and poles, the latter being fitted with wrought iron tubular sockets for a total length of 17 feet at the bottom end.

The third circuit known as "No. 1" comprises No. 000 B. & S. gauge, copper supported on 35,000 volt pin type insulators, iron cross-arms and light weight steel poles, the telephone circuit being carried directly under one of the high tension transmission circuits.

For the 70,000 volt construction, it is proposed to utilise the No. 0 copper in 2 circuits using the more modern type of suspension insulators and clamps, hung from special iron cross arms of our own design (Drawing No. KL. 303), supported upon the type of steel poles now utilised in No. 3 circuit, after lengthening the same by means of the existing tubular sockets to be removed from the bases of the wooden poles at present in use with Nos. 2 and 3 circuits. The joint between the steel poles and their iron sockets will be made with special reducing couplings.

The steel poles now in use are insufficient in number to permit construction of the two circuits and it will be necessary to draw from own stock 400 poles now existing and purchase from outside, 900 additional.

During re-construction, it will be necessary to temporarily construct auxiliary sections of line utilising the existing wooden poles, insulators and No. 000 copper, to admit of transfer of load from the present circuits during the periods of change from one class of construction to the other.

Upon the completion of the change-over work, the No. 000 copper with its insulators and pins will be removed and placed in storage, if a purchaser is not immediately found.

Upon the removal of the No. 000 copper and its insulators from the temporary circuit, there will remain standing the wooden poles, cross arms and the iron pole sockets, and it is intended to utilise these in their new positions for the support of our telephone wires, which should, for safety in operation, be entirely removed from the poles supporting the 70,000 volt transmission wires.

In re-constructing the transmission circuits, it is proposed to insert complete transpositions every 5th mile to eliminate inductive effects.

For additional protection against lightning discharges, it is intended to erect a standard galvanised iron conductor above the highest transmission wire of each circuit, supported by means of short extensions to the regular transmission poles. These conductors will be connected to earth at and through each pole and auxiliary earth connections will be made where suitable wet ground is found.

It is also intended to re-construct that portion of the over head system which interferes with the proposed tank at Mavattoor, for which an estimate amounting to Rs. 45,000 was submitted to the Superintending Engineer, Western Circle, with this office No. 651, dated 3rd April 1905, and included and sanctioned in the estimate for constructing the Mavattoor tank.

SECTION HOUSES.

The existing Section Houses at Kankanhalli and Sarjapur will be re-equipped for 70,000 volts and provided with transfer and tie switches, by means of which, sections of transmission line may be cut out of service to permit of repairs being made without disturbing the supply of power to the Mines. Details shewing the proposed new arrangements and diagrams of connections are shewn in our drawing Nos. LK–301 and LS–302.

The proposed combination of switches will also admit of the transfer of the full load from one circuit to the other.

STEP-DOWN TRANSFORMER STATION, CHAMPION REEF.

The two 70,000 volt transmission circuits described above will terminate on suitable steel "anchor" towers placed a short distance from the switch tower of the present building to relieve all mechanical strain from the building structure. Short spans will be placed between the anchor towers and the switch building.

The transmission circuits will each be protected with a set of aluminium lightning arresters in addition to the ground conductor carried on the tops of the transmission poles.

For the accommodation of the high tension switch gear and bus-bars, a slight extension to the existing switch tower and its roof is necessary.

The transformer room of the present building will require complete modification along similar lines to the work at Sivasamudram. The 2,300 volt switchboards for distribution to the Mines will, with slight modifications, remain as at present. The 2,300 volt and 70,000 volt oil switches required will be operated by the "remote system of control," while all others will be hand-operated.

The interior wiring on the high and low tension sides will be arranged to permit of either one of the transmission circuits carrying the full load of the system in case of accident or shut down for repairs to the other circuit.

It is proposed to install in the Step-down Station 9 transformers of 1,750 K. W. capacity each to be arranged with widening taps and to be identical with low transformers, to be installed at Sivasamudram. In addition to the 9 transformers, one extra is proposed as a spare.

Owing to the fact that water for circulating purposes can only be obtained from the Bethamangala water works, it is essential that the greatest economy in water for transformer use be obtained. It is therefore proposed to erect a suitable masonry or reinforced concrete storage tank, over which will be erected a modern system of cooling towers combining the natural and forced draught types with a suitable motor-driven circulating pump, by means of which the water may be drawn from the tank, forced through the pipe coils of the transformers and delivered to the cooling towers from which it will be returned by gravity to the storage tank after cooling.

The loss in water due to leakage and evaporation will necessarily have to be made up, by drawing from the local water supply system.

It has occurred to the writer that, with the co-operation of the Water Works department, it should be possible to draw water direct from their main line, pass it to our circulating coils and return the same amount of water to their main without the slightest contamination. The operation expenses to the C. P. S. resulting from such an arrangement would be practically *nil*, as only power for the circulating pumps will be necessary.

The only possible objection is that our requirements of approximately 150 gallons per minute might exceed the minimum daily demand of that portion of the K. G. F. supplied from the water main near the Transformer Station. The subject will be studied further and every possible means employed to economise water consumption which is billed to the C. P. S. at the maximum rate applying on the Gold Fields, thereby placing our department at an apparently unfair disadvantage.

The re-arrangement of the Champion Reef Transformer Station also involves a great deal of complicated work owing to the necessity of supplying continuous service to the mines. It is therefore proposed to limit the danger to life during the re-construction period and facilitate the change over work by installing the present air-blast type of transformers within a temporary building placed in close proximity to the permanent building to admit the removal of all 35,000 volt wiring in the main building during that period.

The temporary building will serve for storing the air-blast transformers until we are able to dispose of them for use in other sections of the Cauvery Power Scheme or for the proposed installations at Bethamangala, Soldevanhalli, etc., etc.

As recently intimated to you, a very large proportion of the 35,000 volt apparatus which will be superseded by the new for 70,000 volt, will be made use of, and should therefore be looked upon as a valuable asset.

Plans.—The proposed re-arrangement of the Champion Reef Transformer Station, with details are shown in the following drawings :—

K. 101. Vertical section showing the general arrangement of Transformer Station.
K. 102. Plan-General arrangement of Transformer Station.
K. 103. Longitudinal section showing general arrangement of Transformer Station.
K. 104. Arrangement of high tension delta and pipe supports.
K. 105. Transformer bank and pipe support arrangement.
K. 106. Details of low tension delta and oil valve control.
K. 107. Arrangement of high tension bus-bar support.
K. 108. Diagram showing system of connections.
K. 109. Proposed arrangement of high-tension leads.
K. 110. Do (continued).
K. 111. Proposed temporary Transformer Station for use during re-arrangement of interior of the present building.
K. 112. End view of Transformer Station indicating in dotted lines the proposed extension to switch gear.

FOURTH INSTALLATION.

Estimate of Costs of Apparatus and Erection.

Item No.		Rs.
	Head Works.	
1.	New forebay in masonry	15,000
2.	Two penstocks complete with valves, etc.	54,000
3.	Estimated freight and carriage charges	17,250
4.	Import duties at 5 per cent	2,700
5.	Forebay outlets including head gates	8,000
6.	Penstock foundations and excavations...	3,000
7.	Erection of penstocks	5,000
8.	Contingencies at 5 per cent	5,250
	Total ...	1,10,200
	Generating Station.	
9.	Sixty feet extension to present building and foundations ...	65,000
10.	Two 2,700 H. P. Water Wheels complete and boxed for shipment.	48,450
11.	Freight and duties on above	7,500
12.	Two 1,500 K. W. Generators complete with couplings and Solenoid operated field rheostats including boxing and freight to nearest shipping Port.	48,300
13.	Freight and duties on above	7,500
14.	New switches for existing generators	9,000
15.	Cartage and erection of two water wheels	7,000
16.	Cartage and erection of generators	6,000
17.	Two generator switch board panels	1,500
18.	Bus-bar copper 2″ × ¼″ Spec. item XL	6,000
19.	Bus-bar supports Spec. item XL1	1,000
20.	Remote Control Mechanisms for 12 generators and 4 exciters Spec. item XLIII-III.	3,000
21.	Conduit for control wires Spec. item XLIII-B	1,500
22.	Switchboard, name plates and miscellaneous wiring materials Spec. item XLIII—A.	1,000
23.	Labour for electrical connections	2,000
24.	Contingencies at 5 per cent	11,000
	Total ...	2,25,750
	Electrical Trunk Connections.	
25.	New 2,300 volt bus-bar mains in generating and Step-up Transformer Stations and interconnection of the two Stations Spec. items Nos. XXX, XXXI, XXXII.	53,000
26.	Remote control cables Spec. items Nos. XXXIII, XXXIV ...	12,650
27.	Erection of bus-bars and removal of present cables ...	2,500
28.	Contingencies at 5 per cent	3,400
	Total ...	71,550

	Step-up Station.	Rs.
29.	Ten 1,750 K. W. Transformers complete with oil and delivered to nearest port of shipment (packing included).	1,29,000
30.	One complete set of spare 70,000 and 2,200 volts transformer windings with insulations, boxed and delivered to nearest port of shipment.	3,825
31.	Bench Board for remote control of generating and Step-up Stations.	6,000
32.	Spec. item II—Remodelling equipment for Bangalore Transformer and Transmission Circuits.	600
33.	Spec. item III—Remodelling equipment for control of eight 720 K. W. Generators.	1,300
34.	Spec. item IV—70,000 and 2,200 volt equipment for the control of first bank new Kolar Transformers.	8,200
35.	Spec. item V—Equipment for control of No. 2—70,000 volt Kolar Transmission Circuit.	8,500
36.	Spec. item VI—Totalizing equipment for Kolar load ..	800
37.	Spec. item VII—1st Regulator and Exciter equipment ...	125
38.	Spec. item VIII—Exciter control equipment	30
39.	Spec. item IX—2nd Regulator and Exciter	100
40.	Spec. item X—70,000 and 2,200 volt equipment for control of second bank of new Kolar Transformers.	8,200
41.	Spec. item XI—One local circuit equipment	700
42.	Spec. item XII— Equipment for No. 1—70,000 Kolar Circuit	8,700
43.	Spec. item XIII—70,000 and 2,200 volt equipment for third bank of new Kolar Transformers.	8,200
44.	Spec. item XIV—Remote control equipment for control of three 720 K. W. Generators.	1,800
45.	Spec. item XV—Remote control equipment for control of existing 1,500 K. W. Generator.	500
46.	Spec. item XVI—Remote control equipment for two new 1,500 K. W. Generators.	1,800
47.	Spec. item XVII—Blank panels (2) for future extensions ...	25
48.	Spec. item XVIII—Equipment for Mysore Transformers and circuits.	800
49.	Spec. item XIX—Other control and synchronizing equipment	75
50.	Spec. item XX—Post insulators and pipe supports for 70,000 volt deltas.	3,000
51.	Spec. item XXI—Bus-bar supports and pipe frame work for all 2,300 volt busses.	600
52.	Spec. item XXII—Post insulators for 70,000 volt bus-bars ...	1,000
53.	Spec. item XXIII—Post insulators for 70,000 leads ...	1,250
54.	Spec. item XXIV—Pipe frame work for 35,000 volt Bangalore busses.	750
55.	Spec. item XXV—Pipe frame work for 35,000 volt Mysore busses.	750
56.	Spec. item XXVI—Control and meter wire for all switches and transformers excluding those in Generating Station.	2,000
57.	Spec. item XXVII—One motor-driven Centrifugal Pump for circulating water complete with piping system.	4,500
58.	Spec. item XXVIII—Copper bus connections for low tension busses.	1,200
59.	Spec. item XXIX—One travelling crane for transformer workshop	5,000
60.	Spec. item XXXV—One special car for shifting transformers within the Station.	1,500
61.	Spec. items XXXVI—VII—VIII—Expanded metal work ...	900
62.	Two sets of 70,000 volt aluminium lightning arresters ...	7,500
63.	Miscellaneous material	2,500
64.	Freight and cartage charges	15,000
65.	Import duties at 5 per cent	11,000
66.	Erection of electrical equipment	15,000
67.	Building extension for bench board	9,600
68.	Building extension for transformer shop	15,200
69.	Building extension for high-tension (70,000 volt) tower ...	20,000
70.	Alterations to existing building	7,500
71.	Temporary Transformer Station	10,000
72.	Contingencies at 5 per cent	16,866
	Total ...	3,41,696

Erection of Transmission Circuits.

		Rs.
73.	9,900-70,000 volt suspension insulators (4 units each) ...	1,07,000
74.	3,000—Suspension clamps	5,250
75.	600—Strain Insulator clamps	1,300
76.	10,000—Cross arm hooks	3,600
77.	1,300—Special steel poles	68,900
78.	1,700—Steel pole reducers	27,200
79.	10—River crossing structures	4,000
80.	Mavattoor tank structures	5,000
81.	3,000—Special galvanized iron cross-arms	75,000
82.	Galvanised iron ground wire	21,344
83.	3,000—Pipe extensions for ground wire	9,000
84.	3,000—Galvanized iron clamps for ground wire ...	3,000
85.	Erection of poles and structures	13,300
86.	Ground wire labor	2,300
87.	Guy wire labor	500
88.	Erection of insulators and wires	4,900
89.	Local freight	5,000
90.	Cartage	7,400
91.	Masonry work for structure piers	3,000
92.	Section house work complete	10,000
93.	Rock blasting	500
94.	Supervision and travelling allowances	3,000
95.	Contingencies	7,500
	Total ...	3,88,494

Removal of old Line Material to Stores.

96.	Removal of poles and structures	4,924
97.	Removal of wire and ceiling same	5,500
98.	Packing of old insulators	300
99.	Cartage and freightage charges	14,295
100.	Contingencies	600
101.	Supervision and travelling allowances	1,000
	Total ...	26,619

Reconstruction of Telephone Circuit.

102.	Removal of existing wire, insulators and cross-arms ...	900
103.	Re-stringing of wire	1,500
104.	Contingencies	500
	Total ...	2,900

Step-Down Station.

105.	Ten 1,750 K. W. Transformers complete with oil and delivered to nearest port of shipment (packing included.)	1,29,000
106.	One complete set of spare transformer windings and insulations.	3,825
107.	Spec. Item I—Bench board for remote control of switches, etc.	8,200
108.	Spec. Item II—Equipment for No. 2 circuit	8,500
109.	Spec. Item III—One high and low tension transformer bank equipment.	4,000
110.	Spec. Item IV—Equipment for No. 1 circuit	8,500
111.	Spec. Item V—One high and low tension transformer bank equipment.	8,200
112.	Spec. Item VI—Alarm relay and gong	50
113.	Spec. Item VII—Pipe work supports and post insulators ...	3,000
114.	Spec. Item VIII—Post insulators for 70,000 volt bus-bars ...	1,000
115.	Spec. Item IX—Post insulators for 70,000 volt leads ...	1,250
116.	Spec. Item X—Control and meter wire for all switches and transformers.	2,000
117.	Spec. Item XI—One motor-driven centrifugal pump for circulating water complete with piping system.	4,500
118.	Spec. Item XII—Copper bar connections for 2,300 volt side ...	1,200

		Rs.
119.	Spec. Item XIII—One travelling crane for transformer workshop.	6,000
120.	Spec. Item XIV—One car for shifting transformers within the Station.	1,500
121.	Spec. Item XV—Expanded metal work	300
122.	Spec. Item XVI—Name plates for switch boards ...	10
123.	Spec. Item XVII—Conduit for meter and control wires ...	1,000
124.	Spec. Item XVIII—One complete water cooling tower with masonry tank.	10,000
125.	Miscellaneous wiring material	2,500
126.	Freight and cartage charges	20,000
127.	Import duties at 5 per cent	10,250
128.	Erection of electrical equipment	8,000
129.	Alterations to interior of existing building	7,500
130.	Building extension for high tension tower (70,000 volts) ...	20,000
131.	Building extension for transformer repair shop ...	12,000
132.	Two sets of 70,000 volt aluminium lightning arresters ...	7,500
133.	Freight, duties and erection	1,500
134.	Temporary transformer station	10,000
135.	Contingencies at 5 per cent	15,000
	Total ...	3,16,285

FOURTH INSTALLATION.

Summary of Estimated Costs and Credits.

Forebay, penstocks and valves		1,10,200
Generating station		2,25,750
Electrical trunk connections		71,550
Step-up transformer station		3,41,696
Transmission circuits		3,88,494
Removal of old circuits		26,619
Re-construction of Telephone circuit		2,900
Step-down transformer station		3,16,285
Grand Total ...		14,83,494
	Rs.	Rs.
Credits.		
310 tons of Line Copper at Rs. 900 ...	2,79,000	14,83,494
12,000 ft. load covered cable	24,000	...
Miscellaneous ,, ,, ...	5,000	...
5,591 wooden poles	17,000	...
7,458 wooden cross arms	3,700	...
30,000 insulators and pins	75,000	...
Air Blast Transformers	50,000	...
35,000 volt switch gear	25,000	...
Switchboards and miscellaneous	10,000	...
Work at Mavattoor tank for P. W. D. ...	45,000	..
5,591 lengths of 7" diameter pipe 12' long ...	17,000	..
Total Credit ...	5,50,700	5,50,700
Total Net Cost ...		9,32,794

APPENDICES.

(1)

Report dated 7th April 1908 by Dr. W. F. Smeeth, M.A., D.Sc., B.E., F.G.S., ETC., *State Geologist and Chief Inspector of Mines in Mysore.*

Site of Dam.—The site which has been selected for the dam is situated on the Cauvery River about one mile north-west of the village of Honghalli and about eight miles west of Seringapatam. The rocks in the neighbourhood of the proposed site are a gneissic granite with included bands of hornblendic schist or epidiorite, the whole complex having a strike a little east of north and dipping steeply either east or west. They are for the most part decomposed to a depth of several feet, but there will be no difficulty in securing a good solid foundation right across the river valley with a reasonable amount of excavation.

I visited the site in June 1907 in company with Captain Dawes, Deputy Chief Engineer, and inspected the ground and some few trial pits which had been sunk. I found that a short distance to the west of the proposed line of the dam there was a very strong and solid run of the hornblendic rock crossing the river and extending well up the south side of the valley, and it appeared to me that a better foundation could be secured at this point with less excavation than would be the case along the line which had been chosen. Some trial trenches were put in, which confirmed this view; but on working out the levels it was found that more masonry would be required and that the cost of the whole dam would be increased and that, provided that good foundations could be secured along the original line, it would be less expensive to adhere to it. A number of trenches have therefore been made to a depth of some 20 to 25 feet across the original line, and on the 4th of April 1908 I inspected these with Captain Dawes. These trenches show that along the greater portions of the line of the dam there is a strong run of hornblendic rock which is quite suitable for the foundations at a depth of less than twenty feet. Associated with this hornblendic rock are bands and wedges of very micaceous gneiss or mica-diorite which appear to be due to alteration of the hornblendic material by the intruding gneissic granite. These micaceous bands are softer and more decomposed than the hornblendic rock, and will require to be scooped out to a somewhat greater depth than the latter, but in no case is the depth likely to exceed thirty feet before good sound rock for foundation purposes is reached. At the north and south ends of the dam, the ground rises into granite knolls where sound rock will be found at the surface and where waste weirs may be advantageously constructed, if required.

On the whole, I am of opinion that the site now selected is an excellent one and there is no doubt that good sound foundations can be secured right across the valley. In the river bed itself the rock is good enough for foundations without excavation, save in the case of a few patches of micaceous material which will have to be taken out for a few feet and filled in with concrete; the rest of the surface will merely require shallow dressing.

On the north and south banks the excavation necessary will not exceed an average of between 20 and 25 feet in order to reach good sound rock for the foundations.

Both the hornblendic rock and the granite close to the site can be used for the purpose of building the dam. I might suggest that a large proportion of the hornblendic rock should be used as, owing to its higher specific gravity, it will materially improve the stability of the dam, volume for volume. This rock should be used for the interior portions of the structure, the external facings being made of granite which is easily dressed and will also absorb less heat thereby reducing strains due to changes of temperature.

(2)

Doctor W. F. Smeeth was again requested to inspect the foundations in the river bed after they were exposed in May last and the following is the report submitted by him (vide *his No. 2203, dated 18th May 1912*).

In reply to your letter No. 3741, dated 10th May 1912, I have the honor to state that I inspected the foundation of the Cauvery Reservoir Dam on the 16th instant in company with Mr. Balaji Row, B.A., Prospector, who had previously made a Geological examination of the rocks in the neighbourhood of the dam site.

2. The portions which I inspected extend about 350 feet into the river from the right bank and back into the right bank for about twice this distance.

3. In the river bed, the rock has been excavated to a depth of about 8 feet and over the greater portion of this area the rock is sound and will form a first class foundation. The rock exposed is a fresh mica-hornblende gneiss and is as good as one could wish from the point of view of strength, permanance and freedom from percolation, which latter should be quite small and without injurious influence on the rock.

4. In places there are a few transverse joint planes, but they are very tight and the rock adjoining them has not suffered any sensible deformation or crushing.

5. In a few places and chiefly near the up stream edge of the foundations, there are some soft spots where veins of quartz or pegmatite have intruded the gneiss parallel to the length of the dam. In contact with these veins the gneiss has been altered and is softer and more micaceous than elsewhere. These softer portions should be scooped out for 3 or 4 feet below the general level of the rest of the foundation and they will then be found to be much harder and more compact, though not so hard or compact as the bulk of the gneiss. They will make no appreciable difference to the general soundness and stability of the foundations and it will be necessary merely to fill up the scooped out portions with cement concrete. I might perhaps suggest that for filling in these portions it would be better to use clean rounded pebbles from the river with the cement rather than broken stone, as being likely to give a greater resistance to simple crushing.

6. As soon as these softer portions have been scooped out and any portions of rock which have been fractured by blasting have been removed, the masonry may be commenced; the excavation is on the whole deep enough now and there is nothing to be gained by going deeper.

7. Before doing so I would suggest that the whole surface be given a good grouting of liquid cement to fill up minute sun cracks which may have opened on the freshly exposed surface.

8 In the portions of the excavations extending from the river up the right bank, a fair amount of soft material still requires to be excavated, but the hard mica-hornblende gneiss has been exposed in several places and there is no doubt that quite satisfactory rock will be found all over the area at a reasonable depth which will be at a higher level than in the river beds though the depth from surface will be greater. The change from the softer decomposed rock to the hard fresh rock will be rapid and no difficulty will be experienced in deciding how deep to go. Mr. Subba Rao, the Superintending Engineer, who showed me over the work, appears to understand just what is required.

9. On the whole, I may say, that the case is a simple one and the excavations made just about bear out my original prognosis and that there can be no question about the foundations on this side of the river proving entirely satisfactory.

10. On the left bank it is probable that things will not be quite so simple or so favourable, but I do not apprehend any real difficulty there. I shall take an opportunity of inspecting that side when the excavations are more forward.

(3)

Letter No. 2680, dated the 29th April 1913 from the State Geologist in Mysore, to the Chief Engineer of Mysore, Bangalore.

In continuation of my previous letter No. 2593, dated the 14th April 1913 on the subject, I have the honour to state that I paid a visit to Kannambadi on the

19th instant and was shewn over the foundations of the Dam by the Superintending Engineer, Mr. Subba Rao. The rock in the mid stream section which has now been excavated is quite satisfactory and the laying of foundations may be commenced as soon as the surface has been cleared up.

2. I also inspected a section on the north bank where excavation is in progress and am satisfied that it will be necessary merely to take out a few of the soft micacious patches for a few feet deeper; the bulk of the rock exposed in this section is quite satisfactory. The excavation already made to the north of this last section shows up quite favourably and I have now no doubt about sound rock being obtained at a reasonable depth throughout the whole length of the Dam.

3. In a previous report I noted that some trouble might be experienced on the northern bank owing to considerable veining giving rise to softer and more easily decomposed materials. The excavation now made shows that no serious difficulty need be anticipated and that the foundations will require to be carried down little, if at all, deeper than on the southern bank of the river.

4. I have personally gone over with Mr. Subba Rao, all points requiring his special attention.

(4)

Note dated 3rd April 1911, by Mr. B. Subba Rao, L.C.E., Executive Engineer, on the Preliminary Project for the North Bank Canal from the proposed Cauvery Reservoir at Kannambadi.

A line for a canal has been traced on the north bank of the Cauvery river to irrigate lands in the dry tract in the taluks of Mandya, Malvalli, Nagamangala, Kunigal and Channapatna. This line is further continued towards Closepet and Kankanhalli and it tails off into the low ground in the State Forests on the left bank of the Arkavati, a little above its junction with the Cauvery. The alignment has been taken so far with the object of finding out the utmost limits of irrigation on the north bank possible from the Cauvery with a reservoir on it constructed near Kannambadi.

(*a*) The line starts from the reservoir, with a canal bed at 60′ above bed of river and running close by French Rocks town, crosses the Lokapavani river about five miles beyond it; the formidable Hulikere-Karighatta range of hills is next crossed, the line thus entering the Shimsha valley. The line then following close to the northern boundary of the Mandya Taluk crosses the Bindenhalli tank valley and passing by Devlapur in the Nagamangala Taluk, crosses the Shimsha into the Kunigal Taluk. It has below it large extent of lands in the Kunigal and Huliyurdurga Taluks and commands practically all the good land in the Channapatna Taluk. This line forms the main canal line.

(*b*) Several branch canals will be required to irrigate lands; these have not yet been aligned. The canal line beyond Channapatna is also treated as a branch line. Shortly after it leaves Channapatna, a high ridge forming the watershed between the Kanva and Arkavati has to be crossed. Beyond this the line follows the left bank of the Arkavati.

2. In the first stage of the scheme no canal will be excavated. The storage in reservoir will be made use of (1) to guarantee minimum supplies in the hot weather months for power generation at Sivasamudram, (2) for protecting hot weather crops and extending them and (3) for bringing under irrigation, should work to the second stage of the reservoir be not taken up shortly after the first stage is completed, about 25,000 to 30,000 acres of new lands by extending the Chikdevarayasagar channel on the north bank, and either the Devaroy or Virjanadi channel on the south bank of the river, at a cost of about Rs. 16 lakhs. A separate Memorandum is submitted on this subject and a copy of it will be found as Appendix M.* among the papers connected with this project.

3. In the second stage of the scheme it is proposed to excavate the canal to 48 miles in length, tailing off into the Bindenhalli stream, a tributary of the Shimsha river.

*Not printed.

4. The bed fall proposed for the canal varies from 0·8′ per mile to 1′ per mile in ordinary ground; it is 2′ to 3′ per mile in the smaller cuttings; 4′ per mile in the open cuttings on either side of the Hulikere saddle and 8′ per mile in the tunnel to be bored through this ridge.

5. The depth of flow in canal will be from 12′ or 10′ at commencement to 5½′ at the tail end of the main canal.

6. The bed width varies from 86′ to 43′ where the line runs in contour and 53′ to 46½′ in cuttings. In the Hulikere tunnel the sectional area is 18′ diameter.

7. The canal is designed to have discharging capacity of 3,000 cusecs including provision for absorption and other losses on the way.

8. A very rough estimate for excavating the canal in the second stage of the scheme 48 miles in length to irrigate 125,000 acres, comes to about Rs. 106½ lakhs including the subsidiary works and branch canals.

9. The area proposed to be irrigated by the canal between the Hulikere saddle and the Bindenhalli stream is about 125,000 acres, which is 46 per cent of the lands commanded. It is not proposed to irrigate the lands commanded by the canal in the first section up to Hulikere saddle as (1) the soil is sandy and poor, (2) the present Chikdevarayasagar channel runs below it at a short distance and (3) there is sufficient wet cultivation already in this tract.

10. The Bindenhalli stream into which the canal tails in the second stage joins the Shimsha a little above the Maddur anikat. Investigations are being made to see if a large reservoir can be constructed either across the Bindenhalli stream or across the Shimsha itself. The value of a large reservoir in this dry tract with a feeder from the main Cauvery River is obvious. Cultivation can be extended on to the left bank of the Shimsha, a branch channel being taken off either from the new reservoir to be constructed on the Shimsha or from the Maddur anikat referred to above. This subject will be gone into in detail when the detailed project is being got up.

11. A canal on the right or south bank of the Cauvery may also be constructed from the reservoir. Such a canal will command about 120,000 acres before it reaches the Kapila River. Should such a canal be opened, at least 50,000 acres of land can be irrigated by it and it will enable the Hulhalli channel drawn from the Kapila being extended in the T.-Narsipur Taluk up to British limits.

12. The accompanying plans, statements and estimates furnish full information on the subject. As noted before, only the general line for canal has bee traced; proper surveys and sections will have to be undertaken after the scheme is generally approved.

(5)

Note on the Hulikere Saddle, dated 5th December 1910, by Mr. B. Subba Rao, L.C.E., Executive Engineer.

The left bank canal for the proposed Cauvery Reservoir at Kannambadi has to cross the Hulikere-Karighatta range of hills, separating the narrow Lokapavani valley from the vast extent of culturable land in the Mandya, Malvalli, Nagamangala, Kunigal and Channapatna Taluks, which is subject to chronic complaints of drought. These taluks are in the drainage of the Shimsha River. The range runs north and south parallel to the Lokapavani, from the Nagamangala Taluk in the north to the bank of the Cauvery River at Karighatta, two miles to east of Seringapatam on the south.

2. The contour line for the canal, which starts at 60′ above bed of river at the Reservoir site, *i.e.*, at R. L. 2404·00, referred to mean sea level, crosses the Lokapavani close to the village of Kalenhalli (*vide* Topo Sheet No. 56, North Latitude 76°-47′) about six miles to north-east of French Rocks. The Hulikere range lying immediately to the east was carefully examined for a suitble site for crossing it. The country to the north of Kalenhalli further up the Lokapavani valley, rises rapidly and the canal cannot be taken in that direction.

(*a*) A mile to east of Kalenhalli and midway between it and Hulikere village, is a saddle whose summit is R. L. 2515·00. The grade level of canal bed at this place being about 2,360·00, the canal bed will have to be about 155′ below surface.

(*b*) In the portion of the range to the south, four of the lowest saddles were examined. They are all higher than the Hulikere saddle and there will be considerable increase in length without adding to the extent of culturable lands under the canal, should any of these be chosen for the canal line. Examination was also made of the route round the south end of the range at Karighatta. Such a line on the steep western and southern slopes of hills and lying just above the Chikdevarayasagar channel will have to run 40 or 45 miles from the Lokapavani River crossing, before any appreciable extent of culturable land with requisite population to cultivate them is reached.

(*c*) It is therefore decided to adopt the Hulikere saddle for crossing the range. It lies moreover not far from the direct route to the dry tracts referred to in para 1.

3. There are outcrops of granite rock here and there in the ridge and the rock under the surface is likely to be hard and mixed up with hornblende and mica. Some trial pits have been arranged to be put in but it will take some time before the nature of the soil can be made out. In the meantime, this *ad-interim* report is got up to explain roughly the nature of the obstacle on the way and of the work to be provided for in the preliminary estimate for the canal now in hand.

4. The accompanying section shows the Hulikere saddle with the line for canal to cross it in miles 24 to 29. Between miles 25½ and 28, the canal bed will lie over 60′ below surface. Enclosures Nos. 1 and 2 show quantities to be removed for a canal capable of discharging 2,500 cusecs of water (this is what is required to irrigate 80,000 acres of rice and 45,000 acres of sugar cane and other valuable crops, the duty of water being taken as 50 acres of rice per cusec). Quantities to be taken out for a canal in open cutting throughout are given in Statement No. 1, and in the No. 2 Statement are noted the quantities for an open canal until the cutting is about 60′ from surface with a tunnel for the portion where the depth is over 60′. The section for the canal will be reduced, as far as possible, to cut down quantities requiring removal by giving greater falls to bed. The bed width of canal in the cutting will be made 50′. The sides will be cut to a slope of 1 to 1 for earth and ¼th to 1 for rock. The tunnel will be 18′ in diameter; it will be cut to 20′ diameter generally to make up for a masonry wall to protect sides and top of tunnel where required.

5. As instructed by the Chief Engineer, I went recently to Kolar Gold Fields and with the kind permission of Mr. R. P. H. Bullen of the Ooregum Mines, inspected rock drilling and blasting work in a tunnel in Oakley's shaft about 2,000 feet below surface. The rock there is hard quartz. The drilling and blasting work is carried out on contract with tools, explosives, etc., supplied by the Mining Company. Explosives and steels used up form a very large item and their price is adjusted in the bills of contractors. The contractor removes the material loosened four or five feet from site, just sufficient to enable his proceeding with further work. The other works in this connection, supplying motive power to work the drills, haulage and hoisting of the stuff removed, pumping water, protecting sides of tunnel, where required, with timber, etc., are carried out by the Company through other agency. The tunnel is 5′ × 7′ which is the uniform section for tunnelling in the fields and the contractor gets paid Rs. 23 for each running foot of tunnelling.

(I also inspected, with the kind permission of Mr. Merwyn Smith, drilling and blasting work in the East Betrayaswami Mine. The drilling about 200′ from surface is being done by hand power, other conditions being the same as in Oakley's shaft. Here the rate paid to the contractor is Rs. 25 per running foot of tunnel.)

The rock drill (obtainable from Holman Bros., Cambourne, Cornwall) in Oakley's shaft is in charge of three men and is worked by compressed air at 60 lbs. pressure compressed and let down in pipes by electric power from a motor placed on the surface. (In some other places, steam power is used to compress the air.) Each drill bores 18 to 20 holes per day, the depth of the holes being 2½′ generally. When blasted, for which about 15 lbs. of gelatine are used, about 2′ of rock are loosened. The contractor gets Rs. 2 × 23 or Rs. 46 for this. The cost of the explosives and of the steels used up will be deducted from this amount and the contractor gets a small margin for this work.

6. At the rate work is carried out on the fields, one cubic foot of drilling and blasting costs $\frac{23}{7\times5}$ Rs. or 10½ annas per cft.

(*a*) The hard granite that we have in the Hulikere saddle may not require so much of explosives as the quartz does in the fields and recently patents have been taken out for electric air drills (The Temple Ingersoll Electric-Air rock drill, Ingersoll Rand Company, New York) which, it is claimed, can do three times the amount of work that the rock drills now in use on the fields can do under the same condition. The pumping plant of the Mysore City Vani Vilas Water Works at Belagola is now worked by electric power from the Sivasamudram Power Station and with a small extra expenditure, a wire can be taken to Hulikere, 14 miles from Belagola, to work the drills and for haulage and hosting of materials, pumping water, working mortar mills, etc. It may be noted here that fuel to generate steam is extremely costly at the place and steam power will not be economical. With electric power the work may be carried out at lower rates than on the fields. These Electric-Air drills have not yet come into use on the fields. There is also this advantage with the Electric-Air drills, that no separate air compressors with long lines of pipes for the compressed air are required, as the speciality of the drill is that it has a small air space in it which is used to compress the air to work the drill. The cost and further details will be ascertained and further information collected shortly. In the meantime, provision more or less similar to what is found on the fields will be made in the preliminary estimates for the canal. The rate for drilling and blasting is reduced to 8 annas a cft.

7. Taking three years as the period within which our tunnel work should be completed, we have to get through 13 feet a day on an average. This requires about 60 drills with 20 air compressors to work them. To make up for damages and accidents, it may be advisable to provide for 100 drills and 40 compressors each of 12 to 15 H.P. The cost of drills in use in the Mines is about £25 each and the air compressors cost about £300 each. The power to work them will have to come from the State electric power generation works and only the cost of the transmission wires with branch wires to work need be provided for in the estimate. Four ventilation shafts, half a mile from one another, will be provided and advantage may be taken to proceed with tunnelling work from these intervening points also.

8. The difficulty from water is not likely to be great, as the slopes of the ridge are steep and the Lokapavani on the west can drain the place rapidly. On the east side, there may be more trouble but this is not likely to be much. A few pumps (to be worked by electricity) with necessary pipes, hoses, etc., will be provided for in the rough estimate.

9. Tramway rails with trucks for carting away the stuff removed will be required for a total distance of 2½ miles. Also, windlasses, crabwinches, mortar mills, wire ropes, etc., will be provided for. Some of these should be available from among the general stores at Bangalore. The rest have to be purchased.

10. During tunnelling, the sides and top in several places may need temporary protection and provision will be made for such work with timber, dindiga, casuarina, teak or other wood, ½ square foot in section, for about 5,000′ length. This may require about 10,000 cubic feet of timber.

11. Portions of the tunnel may need permanent protection to the sides and top and provision will be made in the estimate for 1¼ mile length for a ring of masonry 2′ thick to protect the sides. This will require about 300,000 cubic feet of masonry.

12. Provision will also be made for hutting arrangements, drainage, medical treatment, etc. The saddle is in a healthy tract and much sickness is not likely to occur. The skilled labour having to be all imported, precautions are necessary. A few good timbermen to see to proper timbering to protect the sides and some smiths to point chisels for the drills are necessary and trained men will be got for this work.

13. Very large amounts are needed for the requisite explosives, candles and steels and considerable reduction in cost may be secured by directly importing explosives from the firm in Scotland (Noble's explosives can be bought from the Swedish makers by Sir Charles Tennant. Messrs. Best & Co., of Madras are agents), and the steels can also be obtained from one of the firms. They are now sold as follows:—

(1) Blasting gelatine Rs. 1-14-6 per lb; sextuble detonators, 5-0-0 per 100; white double tape fuze 0-11-0 for a 24′ coil.

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(Departmental Library)
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ಸ್ವೀಕೃತ Date 18/8/82

(2) Candles (Burman candles through Best and Co..) cost 4½ annas per lb; one candle will do for seven or eight hours for each party.
(3) Good steels ⅞" octagonal are used for drilling.
(4) Second hand wire ropes may be had in the Fields. As these articles are very largely required for the work and as their cost is high, attention should be paid to get them from the cheapest places.

14. Some of the stones removed by blasting will no doubt be useful for masonry works in the neighbourhood and credit may be found possible to be afforded to the tunnel work.

15. Rough estimates may now be framed of the cost of getting through this ridge.

		Rs.
(1)	Earthwork—815,123 cyds. at Re. 0-3-0 per cyd.	1,52,835
(2)	Canal in open cutting in miles 24 to 25½ and 28 to 29—419,180 cyds. at Rs. 1-8-0 per cyd.	6,28,770
(3)	Tunnelling in miles 25½ to 28—4,148,581 cft. at Re. 0-8-0 per cft. ...	20,74,290
(4)	Sinking shafts—23,004 cft. at 0-8-0 per cft.	11,500
(5)	Timbering weak portions temporarily—10,000 cft. at Re. 1-0-0 per cft. ...	10,000
(6)	Lining with masonry where needed—300,000 cft. at Rs. 25 per 100 ...	75,000
(7)	Hoisting and haulage ... ... L. S.	2,00,000
(8)	Pumping ... ... L. S.	50,000
(9)	Hutting charges, sanitation, medical, etc., for three years at Rs. 20,000 each	60,000
(10)	Repairs and working charges for machinery, etc.	1,50,000
(11)	Sundries, compensation, transmission lines for electric power and temporary establishment, etc. ... ... L. S.	87,605
	Total ...	35,00,000

16. These provisions will be entered in the preliminary estimate and checked, as detailed surveys are made and further information is collected.

From the above amount we may expect about Rs. 3 lakhs to be returned, as per margin, when the work is completed. So the net cost of the tunnel work may be roughly put down at Rs. 32 lakhs.

Machinery, tools and plant ...	2½ lakhs.
Stones from the work ...	½ „
Total ...	3 „

(6)

Report dated 16th February 1911, by Mr. B. Subba Rao, Executive Engineer, on the preliminary estimates for opening a channel from the Sivasamudram anikat to the right bank of the Shimsha River, for supplying water to work the turbines of the proposed power installation at the Shimsha Falls.

Reference.

In my letter No. 240, dated 11th September 1910, to the address of the Chief Engineer of Mysore, I submitted a first report on the scheme. In accordance with the Chief Engineer's personal instructions on the subject the following preliminary proposals have been got up.

II. The Shimsha Falls, situated North Latitude 12° 20′ 45″ and East Longitude 77° 14′ 30″ (*vide* Topo Sheet No. 61) offer, owing to greater head available, better facilities for generating Electric Power than the Cauvery Falls at Sivasamudram; the depth of the bed of the Shimsha River below its right bank at the site selected being 622′ (*vide* Statement A enclosed), while the head at the Bluff where the present Cauvery Power Station is situated is 386′. It is clear that for given quantities of water to work the turbines we can generate at Shimsha Falls $\frac{622}{386}$ or 1·63 times the power that can be generated at Sivasamudram. There is, however, this main difficulty, that the Shimsha, except for short periods during the monsoons, carries but small quantity of water, while in summer the flow is quite insignificant.

The question as to whether sufficient supplies cannot be secured to make use of the Shimsha Falls for power generation has been under consideration for some time past.

Help from the Cauvery.

III. The only sure source of supply in the neighbourhood is the Cauvery which carries down considerable volumes of water steadily for eight or nine months in the year. The project for constructing a reservoir across this river for storing sufficient supplies in it to make up for deficiency in the hot weather months as well as for safeguarding supplies to

the present irrigation in the valley and extending it into the tract of country to the north of the Cauvery, subject more or less to chronic complaints of drought and loss of crops from failure of seasonal rains, has been recently submitted for orders. With such a reservoir on the Cauvery to safeguard supplies in the low supply season, the possibilities of increased power generation are immense. On the Shimsha a site was investigated in the Kunigal Taluk where a reservoir can be constructed, but the distance from it to the site for the Power Station is so great and the bed of the river so sandy that only very small portion of water let down from the reservoir would reach the Power Station. Further, the cost of constructing such a reservoir would be very high. There is no other sure source of supply to work the turbines should they be installed at the Shimsha Falls.

From the proposed reservoir at Kannambadi direct.

(*a*) Several proposals have been investigated to see how the Cauvery water can be most economically led to the Shimsha river bank. In 1908 Captain Dawes worked out a preliminary scheme for constructing a covered aqueduct from the proposed reservoir on the Cauvery at Kannambadi to the site of the proposed Power Station on the Shimsha to carry the requisite quantity of water for working the turbines to generate about 40,000 horse power of electrical power. The cost of this duct was estimated at Rs. 69 lakhs. The total head available at the Falls is 622′ and it cannot be increased without unduly lengthening the pipe line which is very costly.

Through the Chikdevarayasagar channel.

(*b*) The Chikdevarayasagar channel drawn from the Cauvery on the north bank is 65 miles in length. By widening and improving it and extending it by another 25 miles, a low saddle in the watershed line between the Cauvery and the Shimsha is reached at a place called Kebbepur. By cutting through this saddle, Cauvery water can be dropped into the Marehalli tank in the Shimsha valley close to the town of Malvalli. By enlarging this tank and taking a channel from it to the Shimsha river, bank water may be delivered to work the turbines at the Shimsha Falls.

(1) The cost of this work would be about 52 lakhs of rupees.

(2) Considerable losses from absorption and evaporation in the more than 110 miles of open channel and the difficulty of properly maintaining it have to be faced.

Through the Ramaswami channel.

(*c*) The Ramaswamy channel, which is next below the Chikdevarayasagar channel on the north bank, may also be widened and improved and extended at a cost of about 40 lakhs of rupees. The effective head in this case also is 622′ and the total length of open channel 29 miles.

(*d*) Similarly, the Madhavamantri channel can also be extended from its present tail end at the Belakavadi tank and through the Rottikatte ridge or round the Prethabetta hills up to the Shimha river bank at a cost of about Rs. 25 lakhs. The effective head in this case also is 622 ft. and the total length of open channel 29 miles.

From the Sivasamudram anikat.

(*e*) A new channel may be excavated from the Sivasamudram Anikat across the Rottikatte ridge and the Handihalla stream to the Shimsha river bank. The length of open channel will be 9 miles up to the Forebay reservoir and about $1\frac{3}{8}$ miles beyond it, either in duct or pipes. The effective head in this case also is 622′ and the cost will be about $13\frac{3}{4}$ lakhs of rupees.

Steel flume.

(*f*) A steel flume direct from the forebay reservoir at the Cauvery Power Station to the site of the proposed Power Station on the Shimsha will also be very costly.

N.B.—Of the above, (*b*), (*c*) and (*d*) have, besides their large initial costs, vast extent of irrigation under them and owing to the great lengths of open channels the losses due to evaporation and absorption will be considerable. Their having to serve at the same time the two purposes of irrigation and supplying water to work the turbines, is sure to involve us in difficulty and losses in revenue are certain to result. Of the remaining two proposals (*a*) and (*e*), the former is considerably more costly than the latter.

Channel from Sivasamudram anikat selected.

The following remarks refer to (*e*), *viz.*, excavating a channel from the Sivasamudram anikat to the Shimsha river bank for supplying water to work the turbines of the proposed Power Station there.

SECTION 2.

IV. The proposals are:—(1) Constructing a Head-sluice to regulate supply from the river, (2) excavating a channel to carry water from the Cauvery to the Shimsha river bank, (3) constructing a Forebay reservoir at the tail end of the open channel and (4) constructing necessary residential quarters and other buildings. The pipe line, penstock, generation and transformer houses as also electrical machinery are not included in the above. Provision for these has to be made after estimates are prepared in the Electrical Department.

Proposals.

V. A Regulator, similar to the Head-sluice now existing at the Sivasamudram Anikat, will be built adjoining it so as to be capable of discharging about 500 cft. of water. The design will be the same as that of the existing work and will cost about Rs. 20,000. Draft clearing necessary for giving approach to water from the river above, is provided for. Also, the bridge across the river at this place will have to be extended towards the west to enable supplies reaching the Head-sluice.

Head-sluice.

VI. The starting level of the channel bed is R. L. 1,989·0. The new channel will be capable of discharging 500 cft. With 500 cft. about 18,000 horse-power can be generated at the Shimsha Falls after meeting all losses from absorption and evaporation on the way. The bed widths and falls given are as noted below. The soils have been classified as could be judged from the trial pits now sunk.

Channel.

Bed widths.

38 feet in ordinary soil,
24 feet in rocky soil and
18 feet in deep cutting where rock is expected to be met with.

Fall.

0·25 per 1,000 in earth,
0·75 per 1,000 in rocky soil and
1·00 per 1,000 in deep cuttings and ridges where rock is expected to be met with

Slopes.

1 to 1 in earth,
½ to 1 in rocky soil and
¼ to 1 in rock.

The velocities developed will not exceed 2½′ per second in earth, 3¾′ per second in rocky soil and 4½′ per second in rock. The soils can stand these velocities and the difficulty from weeds and silt is not likely to be met with.

Velocities.

The channel starts from the Sivasamudram Anikat close to the existing channels to the Cauvery Power Station, runs parallel to them for some distance and then, deviating to the west, crosses the road to the Bluff.

The following ridges are crossed in the line. Rottikatte ridge from $\frac{6}{2}$ to $\frac{3}{3}$ mile, Kolar old transmission line ridge in $\frac{2}{8}$ to $\frac{4}{8}$ mile, Netkal ridge in $\frac{2}{9}$ to $\frac{3}{9}$ mile and Kolar new transmission line ridge in $\frac{6}{9}$ to $\frac{8}{9}$ mile.

Ridges to be crossed.

The greatest depths of cuttings in these ridges are 51′, 37′, 33′ and 30′, respectively.

In mile $\frac{2}{5}$, the Handihalla stream, whose bed is 52′ below the channel grade level, is crossed. A reservoir is proposed to be constructed across the stream and the channel taken through it. This is a pretty large drainage, the total catchment being about 18 square miles. The capacity of the reservoir to be built here is about 255 units or 67 millions cft. which would suffice for two days to keep the turbines working, should by any chance there be any stoppage in supply of water through the channel. In my first report I had proposed to make a balancing tank here. The Chief Engineer and the Chief Electrical Engineer being, however, of opinion that it is not necessary so long as we have a Forebay reservoir capable of storing a ten hours' supply, this balancing tank has been given up and there is consequently some increase in head secured. Three other smaller drainages as noted in the statements will also be crossed through reservoirs to be constructed. This means of crossing is proposed only where the other methods of crossing are costly. In the case of these reservoirs, the top level of bund is made 6′ above F. S. L. of tank and provision made for weir escapes capable of disposing of maximum floods with a head on

Cross drainages.

crest not exceeding 2'. The other minor streams will be crossed by aqueducts or super passages. In a few places relieving weirs will be constructed where rocky sites at proper levels are available. Detailed calculations will be found in the papers enclosed.

Check drains. The estimates provide for opening check-drains to lead off drainage into natural water course to avoid damages to channel.

Forebay reservoir. At the tail end of the channel a Forebay reservoir capable of storing 10½ hours' supply for working the turbines (should channel be placed out of action on any account), is proposed to be constructed. The penstock head may be fixed in this reservoir and provision is made in the estimate for the outlet for this purpose. Details for this will be worked out after the Electrical Department portion of the proposals is matured. From this point downwards up to the generating house, provision will have to be made in their estimate.

Cart and foot bridges. Provision is also made for cart and foot bridges to accommodate the public using the jungle on either side of the channel line. The inhabitants of the neighbouring villages use the forests for cattle grazing purposes and for bringing wood for fuel and agricultural purposes. There is also some forest produce to be collected.

Buildings. The buildings to be constructed will be similar to those at the present Power Station. Their exact positions, etc., will be decided after the electrical portion of the estimate is ready.

Roads. A service road for facility in carrying machinery, branching off from the Maddur-Sivasamudram road, from near Dassandoddi or some other place near it to the Shimsha river bank, as also for carrying other materials and smaller approach roads close to the buildings, will be opened out and the cost met from provision under the head "Buildings."

Main road deviation. VII. In the first two furlongs the channel line is very close to the Maddur-Sivasamudram road. It is necessary to deviate this road and a sum of Rs. 2,000 is provided for it. The block survey plan of head works shows this.

Compensation. VIII. The channel line to a great extent lies in the Belakavadi village and jungle belonging to the Jahgirdar of Sivasamudram. It is learnt that, when the first installation of the Cauvery Power Scheme was made, a rate of Rs. 20 per acre was fixed as compensation for lands taken in the Jahgir limits. This rate is now provided for. Of the remaining extent of land small portions are occupied and lie in the village of Netkal while the rest are Government waste.

Miscellaneous. IX. Provision is also made in the estimate for sanitation, water-supply, medical and other charges necessary. Arrangements will be made for affording facilities in the matter of procuring provisions for the staff and work people.

SECTION 3.

Materials. X. Stone can be had close by. Lime and sand are also near, but timber and other materials have to come from long distances.

Labour. XI. The labour for the work will have to be imported entirely. There is no local labour available. Some advance may have to be paid in the beginning.

Rates. XII. The rates allowed are according to the prevailing schedule rates of the Cauvery Power Scheme at Sivasamudram.

Maintenance of works. XIII. When the channel is opened and the other works are constructed, a sum of about Rs. 4,000 will be required for annual maintenance :—

	Rs.
Channel 9 miles at Rs. 200 per mile	1,800
Masonry works	700
Repairs to buildings and roads	1,500
Total ...	4,000

Financial aspect of the project.

XIV. As regards the financial aspect of the project, it is clear that 500 c. ft. per second of water delivered on the Shimsha river bank will produce more than one and a half times the amount of power generated at the present Power Station at Sivasamudram. This will fetch about 27 lakhs of rupees per annum gross revenue, or about 24 lakhs net against the sum of 15 lakhs now being realised under the existing scheme. The Electrical Department portion of the estimate may roughly come to about 16 lakhs. The return on the total outlay of about 30 lakhs required for the proposed Shimsha Installation would be about 9 lakhs of rupees per annum. It will therefore be worthwhile considering whether the present power generating plant should not be shifted to the Shimsha river bank, should it be found not possible to have plants both at Sivasamudram and at the Shimsha.

General remarks.

XV. On receipt of approval to the above and after the Electrical portion of the proposals is matured, the final estimates will be completed. The civil engineering portion is not likely to exceed Rs. 14 lakhs.

The report enclosed,* prepared by Mr. N. Rama Rao, Assistant Engineer in charge, is full and I do not think further remarks are needed at this stage.

Statement showing area and assessment under the channels in the Cauvery Valley.

River			Channels	Area irrigated			Total revenue realized	Remarks
Main	Branch	Number		Government	Inam	Total		
Cauvery.	Main.	1	Chamaraja series ...	5,637	1,307	6,944	62,343	
		2	Mirle series	3,891	325	4,216	28,981	
		3	Ramasamudram	5,094	1,160	6,254	37,930	
		4	Tippur	590	420	1,010	6,139	
		5	Rajaparameswari	2,167	1,600	3,767	21,639	
		6	Ramasawmy	3,484	4,591	8,075	58,231	
		7	Mahadeva Mantry ...	2,509	171	2,680	18,414	
		8	Chik Devaraya Sagar ...	13,328	917	14,245	92,286	
		9	Devaraya	1,832	190	2,022	14,181	
		10	Virjanadi	7,047	373	7,420	47,265	
		11	Bangardoddi	681	81	762	5,408	
		12	Bandikere	224	4	228	970	
	Suvarnavati.	13	Hongalwady	2,097	16	2,113	11,102	
		14	Sargur	224	4	228	1,211	
		15	Muralahalli	303	3	306	1,631	
		16	Alur, new	148	7	155	1,271	
		17	Hemma	382	29	411	2,067	
		18	Hosahalli	131	14	145	1,014	
		19	Kudlur	99	...	99	535	
		20	Alur, old	128	...	128	1,087	
		21	Honganur	1,708	90	1,798	8,371	
	Lakshmantirtha.	22	Hanagod series	5,218	35	5,253	21,925	
		23	Kattemalalwadi	590	9	599	2,700	
		24	Husenpur	812	1	813	3,402	
		25	Seruyur	562	...	562	1,866	
		26	Marchalli	403	3	307	2,417	
		27	Anandur	1,394	91	1,485	9,140	
		28	Ayarhalli	147	...	147	729	

* Not printed.

Statement showing the area and assessment, etc.—*concld.*

River			Channels	Area irrigated			Total revenue realized	Remarks
Main	Branch	Number		Government	Inam	Total		
Cauvery.	Kabbini.	29	Rampur	4,615	1,686	6,301	36,253	
		30	Hulhalli	4,388	917	5,305	27,546	
	Nugu.	31	Lakshmanapur	468	2	470	2,249	
	Maddur Tank, Shimsha.	32	Maddur Ane	1,377	116	1,493	8,207	
		33	Kemmannu	925	33	958	6,269	
		34	Vaidyanathapur	222	27	249	1,555	
		35	Bairan	240	40	280	2,002	
		36	Chamanahalli	576	31	607	3,841	
	Hemavati.	37	Mandigere	2,497	546	3,043	20,770	
		38	Hemagiri	19	1,362	1,381	9,506	
		39	Akki Hebbal	330	50	380	2,490	
		40	Kalhalli	869	347	1,216	8,433	
		41	Kannambadi	1,087	69	1,156	8,102	
	Cauvery.	42	Kattepur	3,563	468	4,031	21,568	
		43	Ramanathapur	1,487	152	1,640	8,023	
	Hemavati.	44	Sriramadevar, North ...	5,121	341	5,462	30,613	
		45	Sriramadevar, South ...	796	592	1,388	7,016	
			Total ...	89,411	18,221	1,07,632	6,68,698	

APPENDIX F.

CAUVERY RESERVOIR PROJECT.

Revised statement of water-spread and capacities at different heights of the proposed Dam near Kannambadi

Height above bed	Reduced level	Area		Capacity				Remarks
		In acres	In square miles	In units		In millions of cubic feet		
				In each foot	Total	In each foot	Total	
35	2,379	1,821	2·84	.....	3908·87	.....	1021·62	
36	2,380	1,917	2·98	311·50	4220·37	81·41	1103·03	
37	2,381	1,993	3·11	325·83	4546·20	85·15	1188·18	
38	2,382	2,057	3·21	337·50	4883·70	88·20	1276·38	
39	2,383	2,135	3·33	349·33	5233·03	91·60	1367·98	
40	2,384	2,232	3·48	363·91	5596·94	95·10	1463·08	
41	2,385	2,304	3·60	378·00	5974·94	98·79	1561·87	
42	2,386	2,401	3·75	392·08	6367·02	102·47	1664·34	
43	2,387	2,500	3·90	408·41	6775·43	106·73	1771·07	
44	2,388	2,601	4·06	425·08	7200·51	111·10	1882·17	
45	2,389	2,725	4·26	447·16	7647·67	116·87	1999·04	
46	2,390	2,788	4·35	462·75	8110·42	120·91	2119·98	
47	2,391	2,872	4·48	471·66	8582·08	123·27	2243·25	
48	2,392	2,960	4·62	486·00	9068·08	127·02	2370·27	
49	2,393	3,047	4·76	500·58	9568·66	130·83	2501·10	
50	2,394	3,173	4·98	518·33	10086·99	135·47	2636·57	
51	2,395	3,318	5·18	540·91	10627·90	141·36	2777·93	
52	2,396	3,505	5·47	568·58	11196·48	148·60	2926·53	
53	2,397	3,697	5·77	600·16	11796·64	156·85	3083·38	
54	2,398	3,894	6·08	632·58	12429·22	165·33	3248·71	
55	2,399	4,146	6·47	670·00	13099·22	175·11	3423·82	
56	2,400	4,281	6·69	702·25	13801·47	183·54	3607·36	
57	2,401	4,412	6·90	724·41	14525·88	189·63	3796·99	
58	2,402	4,568	7·14	748·33	15274·21	195·58	3992·57	
59	2,403	4,733	7·39	766·75	16040·96	200·39	4192·96	
60	2,404	4,825	7·53	796·50	16837·46	208·17	4401·13	
61	2,405	5,131	8·01	829·66	17667·12	216·84	4617·97	
62	2,406	5,359	8·37	874·16	18541·28	228·47	4846·44	
63	2,407	5,595	8·74	912·83	19454·11	238·57	5085·01	
64	2,408	5,836	9·12	952·60	20406·71	248·97	5333·98	
65	2,409	6,093	9·52	994·08	21400·79	259·81	5593·79	
66	2,410	6,400	10·00	1041·08	22441·87	272·09	5865·88	
67	2,411	6,724	10·50	1093·66	23535·53	285·84	6151·72	
68	2,412	7,056	11·02	1148·33	24683·86	300·12	6451·84	
69	2,413	7,396	11·55	1204·33	25888·19	314·76	6766·60	
70	2,414	7,827	12·23	1268·58	27156·73	331·56	7098·16	
71	2,415	7,995	12·49	1318·50	28475·23	344·60	7442·76	
72	2,416	8,244	12·88	1353·25	29828·48	353·68	7796·44	
73	2,417	8,501	13·28	1395·41	31223·89	364·70	8161·14	
74	2,418	8,760	13·69	1438·41	32662·30	375·94	8537·08	
75	2,419	8,963	14·00	1476·91	34139·21	386·00	8923·08	
76	2,420	9,281	14·50	1520·33	35659·54	397·35	9320·43	
77	2,421	9,539	14·90	1568·33	37227·87	409·90	9730·36	
78	2,422	9,847	15·38	1615·50	38843·37	422·22	10152·58	
79	2,423	10,100	15·78	1662·25	40505·62	434·44	10587·02	
80	2,424	10,371	16·02	1705·83	42211·45	445·83	11032·85	
81	2,425	10,772	16·83	1761·91	43973·36	460·49	11493·34	

APPENDIX F.—*concld.*

Height above bed	Reduced level	Area		Capacity				Remarks
		In acres	In square miles	In units		In millions of cubic feet		
				In each foot	Total	In each foot	Total	
82	2,426	11,148	17·42	1826·66	45800·02	477·41	11970·75	
83	2,427	11,537	18·02	1890·41	47690·42	491·07	12464·82	
84	2,428	11,925	18·63	1955·16	49645·58	511·00	12975·82	
85	2,429	12,220	19·09	2012·83	51658·41	526·07	13501·89	
86	2,430	12,769	19·95	2082·41	51670·22	541·25	14016·14	
87	2,431	13,225	20·66	2166·16	55906·98	566·14	14612·28	
88	2,432	13,689	21·39	2242·83	58149·81	586·18	15198·46	
89	2,433	14,161	22·12	2320·83	60172·64	606·57	15805·03	
90	2,434	14,580	22·78	2395·83	62866·47	626·17	16431·20	
91	2,435	14,984	23·41	2463·66	65330·13	643·90	17075·10	
92	2,436	15,326	23·94	2525·83	67855·96	660·15	17735·25	
93	2,437	15,675	24·49	2583·41	70439·37	675·09	18410·34	
94	2,438	16,029	25·04	2642·00	73081·37	690·51	19100·85	
95	2,439	16,486	25·76	2709·58	75790·95	707·92	19808·77	
96	2,440	16,922	26·44	2784·00	78574·95	727·62	20536·39	
97	2,441	17,358	27·12	2856·66	81431·61	746·61	21283·00	
98	2,442	17,810	27·83	2930·66	84362·27	765·96	22048·96	
99	2,443	18,258	28·53	3005·66	87367·93	785·56	22834·52	
100	2,444	18,693	29·21	3079·25	90447·18	804·79	23639·31	
101	2,445	19,057	29·77	3145·83	93593·01	822·18	24461·49	
102	2,446	19,408	30·32	3205·41	96798·42	837·76	25299·25	
103	2,447	19,790	30·92	3266·50	100064·92	853·78	26152·98	
104	2,448	20,139	31·47	3327.41	103392·33	869·65	27022·63	
105	2,449	20,528	32·07	3388·91	106781·24	885·72	27908·35	
106	2,450	20,965	32·75	3457·75	110238·99	903·71	28812·06	
107	2,451	21,496	33·59	3538·41	113777·40	921·79	29736·85	
108	2,452	22,021	34·41	3626·66	117404·06	947·86	30684·71	
109	2,453	22,566	35·26	3715·83	121119·89	971·16	31655·87	
110	2,454	23.055	36·02	3801·75	124921·64	993·62	32649·49	
111	2,455	23,636	36·93	3890·91	128812·55	1016 92	33666·41	
112	2,456	24,185	37·79	8985·08	132797·63	1041·51	34707·95	
113	2,457	24,729	38·61	4076·16	136873·79	1065·34	35773 29	
114	2,458	25,321	39·56	4170·83	141044·62	1090·08	36863·37	
115	2,459	25,921	40·50	4270·16	145314·78	1116·05	37979·42	
116	2,460	26,515	41·68	4369·66	149684·44	1142·05	39121·47	
117	2,461	27,116	42·37	4469·25	154153·69	1168·08	40289·55	
118	2,462	27,703	43·28	4568·25	158721·94	1193·95	41483·50	
119	2,463	28,321	44·31	4668·91	163390 85	1220·26	42703·76	
120	2,464	28,960	45·25	4773·66	168161·51	1247·64	43951·40	
121	2,465	29.584	46·22	4878·66	173043·17	1275·08	45226·48	
122	2,466	30.276	47·30	4988·33	178031·50	1303·75	46530·23	
123	2,467	30,976	48·40	5104·33	183135·83	1334·06	47864·29	
124	2,468	31,684	49·50	5221·66	188357·49	1364·53	49228·82	
125	2,469	32,400	50·62	5340·33	193697·82	1397·7.	50626·57	
126	2,470	33,121	51·75	5460·33	199158·15	1427·11	52053·68	
127	2,471	33,856	52·90	5581·66	204739·81	1458·83	53512·51	
128	2,472	34,596	54·05	5704·33	210444·14	1490·88	55003·39	
129	2,473	35,344	55·22	5828·33	216272·47	1523·29	56526·68	
130	2,474	36,011	56·26	5946·25	222218·72	1554·11	58080·79	

Proceedings of the Government of His Highness the Maharaja of Mysore, Public Works, dated 12th October 1911.

READ—Report by the Chief Engineer of Mysore, dated 5th May 1911, and Note dated 8th May 1911, on the Cauvery Reservoir Project and correspondence connected therewith.

C. No. 13-19—84-90, DATED, CAMP MYSORE, 12TH OCTOBER 1911.

ORDER THEREON.—The question of constructing a reservoir across the Cauvery, for developing irrigation in the river valley within the Mysore State, has been under consideration and discussion for over forty years. It has come into prominence since 1902 in consequence of the hydro-electric installation at Sivasamudram. The summer flow in the river is found inadequate for the existing irrigation and power supply and, with the increasing depth of the mines, the Mining Companies require additional power. The Sivasamudram scheme has been enlarged twice to meet the demand and each enlargement has added to the insecurity of the power supply as a whole. To remove this insecurity and provide for additional irrigation and power, a storage reservoir has become indispensable.

2. A project for a reservoir at Kannambadi about 8 miles above the island of Seringapatam was prepared in the year 1908 by the late Captain Bernard Dawes, R.E., Deputy Chief Engineer, under the supervision of Mr. W. McHutchin, M.I.C.E, the late Chief Engineer. The cost was estimated at Rs. 440 lakhs and the project had for its object the irrigation of an area of 300,000 acres on both banks of the river and the generation of electric power to the extent of 70,000 H.P. for industrial and other purposes, both within and outside the State.

As the proposals involved extraordinary expenditure and part of it on the construction of works outside the State, the project was not carried to the stage of practical action.

3. The question was again taken up and fresh surveys were started in July 1910. The surveys and preparation of the project were entrusted to Mr. B. Subba Rao, L.C.E., Executive Engineer, (now Officiating Superintending Engineer) assisted by Mr. M. A. Ananthalwar and Mr. K. R. Seshachar.

At the same time, an estimate amounting to Rs. 8 lakhs for a fourth installation of the Cauvery Power Scheme was prepared by Mr. H. P. Gibbs, M.I.E.E., recently Chief Electrical Engineer to the Government of Mysore (*vide* page 47 of printed report).

A combined project estimated to cost Rs. 253 lakhs (page 15 of printed report) was submitted to Government in May 1911, in which provision was made as under:—

	Rs.
(1) A dam 124 feet high capable of storing a depth of 118 feet of water, or 41,500 million cubic feet....	139 lakhs.
(2) A canal system to irrigate 150,000 acres of land	106 „
(3) Extensions and improvements to the Cauvery Power Scheme to provide additional power to the extent of 5,000 H.P.	8 „
Total	253 lakhs

4. In order to provide for the expenditure in easy instalments, it is proposed to carry out the work in two stages, the first stage of which (*vide* page 13 of printed report) will comprise the following works:—

	Rs.
(1) A dam with a full supply of 80 feet and a storage capacity of 11,030 million cubic feet but of sufficient section for an ultimate storage of 118 feet	81 lakhs.
(2) Extensions and improvements to the Cauvery Power Scheme to generate additional power up to 5,000 H.P.	8 „
Total	89 lakhs.

5. According to an agreement entered into with the Madras Government in the year 1892, the consent of that Government is necessary for the construction of a reservoir across the Cauvery. To this end negotiations were opened about the end of October 1910. The magnitude of irrigation interests in the Madras Presidency led to a prolonged correspondence both with the Government of Madras and the Government of India and the Madras Government have agreed to the construction of a reservoir of 11,030 million cubic feet under certain conditions which have been accepted by His Highness' Government. The Government of India have confirmed the agreement.

6. Negotiations with the Mining Companies have been in progress since May 1910 in the matter of rates to be charged for the protection to be afforded to the existing power supply to the Kolar Gold Fields, and for the additional supply likely to be required by them in the near future. In a letter dated 21st December 1910, Messrs. John Taylor & Sons, acting on behalf of the Mining Companies, have agreed to purchase power at the following rates:—

(1) £12 per H.P. per annum for 10 years, from the date the power supply is protected by storage, on all the supply contracted for.

(2) £10 per H.P. thereafter.

7. The reservoir in the first stage will serve not only to insure the present supply of power and generate the additional power required by the mines but also to provide sufficient storage for adding not less than 25,000 acres to the existing irrigation in the valley. An exhaustive consideration of the project from all points of view leaves no doubt as to its remunerative character and its protective value both for irrigation and power purposes.

The Government of His Highness the Maharaja are therefore pleased to sanction the construction of the first stage of the Reservoir Scheme estimated at Rs. 89 lakhs. As indicated in paragraph 4 above, and explained in greater detail in Section 4 of the Chief Engineer's report, the first stage will meet all immediate requirements in respect of irrigation and power supply in the Cauvery valley.

8. Government are also pleased to direct that construction operations shall be begun at once so that full advantage may be taken of the ensuing working season.

Orders will issue separately regarding the allotment of funds. It may be assumed for the present that a grant of not less than Rs. 10 lakhs will be available during the official year 1911-12.

Proceedings of the Government of His Highness the Maharaja of Mysore, Public Works, dated 7th August 1912.

READ—(1) Government Proceedings P. W. No. C. 13-19--84-90, dated the 12th October 1911, conveying sanction to the construction of the first stage of the Cauvery Reservoir Scheme and the Fourth Installation of the Cauvery Power Scheme.

(2) Public Works Secretary's Note, dated the 30th April 1912, submitting estimates, aggregating Rs. 89 lakhs, for the Cauvery Reservoir Works, for formal sanction.

No. 1027-33A—6586-92A, DATED BANGALORE, 7TH AUGUST 1912.

ORDER THEREON.—In paragraph 7 of the Proceedings quoted above, Government conveyed administrative sanction to the construction of the first stage of the Reservoir and the Fourth Installation of the Cauvery Power Scheme, estimated to cost Rs. 89 lakhs. The Chief Engineer has submitted to Government in the

Public Works Department, detailed estimates for the Reservoir Scheme. The principal items comprised in the estimate are as under:—

		Rs.
(1)	Preliminary expenses	1,00,000
(2)	Land compensation	10,76,700
(3)	Construction of main dam	43,40,230
(4)	Sluices	3,80,292
(5)	Waste weir	6,50,000
(6)	Miscellaneous	3,72,970
(7)	Establishment	6,08,828
(8)	Tools and plant	2,00,000
(9)	Contingencies	3,46,009
	Total ...	80,75,029
	or say, in round figures.	81,00,000
(10)	Fourth Installation of the Cauvery Power Scheme ...	8,00,000
	Total ...	89,00,000

Government are pleased to accord formal sanction to the detailed estimates referred to above. Separate sanction should be obtained to the detailed estimates for the Fourth Installation of the Cauvery Power Scheme.

Proceedings of the Government of His Highness the Maharaja of Mysore, Public Works, dated 5th September 1912.

READ—Government Proceedings (P. W.) No. C. 13-19—84-90, dated the 12th October 1911, conveying sanction to the construction of the first stage of the Cauvery Reservoir and the Fourth Installation of the Cauvery Power Scheme.

2. Government Proceedings (P. W.) No. 1027-33A.—6586-92, dated the 7th August 1912, according sanction to the detailed estimate amounting to Rs. 81 lakhs for the Cauvery Reservoir Scheme, and directing that separate sanction be obtained to a detailed estimate for the Fourth Installation of the Cauvery Power Scheme.

3. Public Works Secretary's note dated the 12th August 1912, submitting a detailed estimate amounting to Rs. 9,32,794 for the Fourth Installation of the Cauvery Power Scheme prepared by the Chief Electrical Engineer to Government.

No. 377-82—C. P. S., DATED BANGALORE, 5TH SEPTEMBER 1912.

ORDER THEREON.—In Government Order dated the 7th August 1912, sanction was conveyed to the detailed estimate for the Cauvery Reservoir Scheme and to a lump sum estimate amounting to rupees eight lakhs for the Fourth Installation of the Cauvery Power Scheme.

2. In submitting the estimate for the Fourth Installation with his No. 386, dated the 31st January 1911, Mr. Gibbs, the then Chief Electrical Engineer, stated that it was more or less a lump sum one and that, on receipt of quotations from foreign firms, a revised and detailed estimate would be prepared.

3. The total amount of the estimate as revised is Rs. 14,83,494. The credit to be given for materials to be removed amounts to Rs. 5,50,700. The net amount of the revised estimate may, therefore, be taken at Rs. 9,32,794, involving an excess of Rs. 1,32,794 over the original estimate.

4. The estimate for the Fourth Installation includes rupees two-and-half lakhs for renewal of existing plant and if this amount is charged to the "Cauvery Power Scheme Depreciation Fund," the outlay required for the generation of additional power and for carrying out desirable improvements may be said to amount to rupees seven lakhs only.

5. With the foregoing remarks, Government are pleased to accord sanction to the detailed estimate amounting to Rs. 9,32,794 for the Fourth Installation of the Cauvery Power Scheme.

6. The proportion in which the amount is to be distributed between Capital and Revenue account may be hereafter settled in consultation with the Financial Department.